

SIEMENS TRAFFIC CONTROLS

Sopers Lane

POOLE

Dorset

BH17 7ER

SYSTEM: TC12

TC12

Installation, Commissioning and Maintenance Handbook

PREPARED: A Pickering

FUNCTION: Engineer

This document is electronically held and approved in Meridian

© Siemens plc. 1997 - 2004 All rights reserved.

The information contained herein is the property of Siemens plc. and is supplied without liability for errors or omissions. No part may be reproduced or used except as authorised by contract or other written permission. The copyright and the foregoing restriction on reproduction and use extend to all media in which the information may be embodied.

Appendix A consists of the latest issue of 667/HB/26628/000.

The current issue of the following A3 drawings are included in the back of this manual:

667/CA/22741/000
667/DZ/22600/000
667/GA/22600/000
667/GA/22603/000
667/GA/22626/000 and 001
667/GA/22635/000
667/GA/22654/000 and 001
667/GA/22670/000
667/GA/22693/000

SAFETY WARNING

In the interests of health and safety, when using or servicing this equipment the following instructions must be noted and adhered to:

Only skilled or instructed personnel with relevant technical knowledge and experience, who are also familiar with the safety procedures required when dealing with modern electrical/electronic equipment are to be allowed to use and/or work on the equipment. All work shall be performed in accordance with the Electricity at Work Regulations 1989.

Such personnel must take heed of all relevant notes, cautions and warnings in this handbook, the General Handbook (666/HB/43100/000) and any other document or handbook associated with the equipment.

The equipment must be correctly connected to the specified incoming power supply.

The equipment must be disconnected/isolated from the incoming power supply before removing protective covers or working on any part from which protective covers have been removed.

The Outstation PCB contains a lithium battery that must be disposed of in a safe manner. If in doubt as to the correct procedure refer to Siemens Instructions CP562

Only authorised/trained personnel are allowed to have access behind the doors/panels of the TC12 Instation Cabinet. Users/operators must not attempt to access anything behind these doors/panels.

Only an authorised/trained person (trained in the safety aspects of working on mains powered equipment) is allowed to setup/change any switch positions in the Instation equipment and/or use any of the free mains sockets within the equipment and/or connect/use the TC12 Instation Test Set at the Instation.

If the Audible alarm on the system fault indication panel (SIP) sounds it should be cancelled as required from the UTC TCC terminal. If the reason for the alarm is a UTC TCC failure, an authorised/trained person (trained in the safety aspects of working with mains powered equipment), should be asked to cancel the audio alarm, using the audio off switch on the PSU PCB.

TELECOMMUNICATIONS APPROVAL WARNING

The Siemens TC12 Modems 667/1/22669/000, 667/1/22668/000 and 667/1/22668/001 and the TC12 OTU/LMU PCB Assemblies 666/1/02262/001 and 666/1/02262/021 are Approved for connection to British Telecommunications Private Circuits in a Multipoint or Point to Point configuration as defined in BS6328: Part 1: 1982, subject to the conditions set out in the instructions for use.

TC12 Modems

Approval Number: NS/1143/2/N/603301

Date: 18/8/92

TC12 OTU/LMU PCB

Approval Number: NS/1143/2/N/603385

Date: 10/11/92

Integral OTU kit

(677/1/27004/000)

The Modem apparatus is intended for use when supplied with power from a source with the following characteristics: +5 V (700 mA), +12 V (110 mA) and –12 V (160 mA). Ensure that the power drawn by this modem together with any other auxiliary apparatus drawing power from the host lies within the rating of the host power supply.

The OTU/LMU is intended for use when supplied with power from a source with the following characteristics: +5 V (2.2 A), +24 V (250 mA). Ensure that the power drawn by the OTU/LMU together with any other auxiliary apparatus drawing power from the host lies within the rating of the host power supply. Other usage will invalidate any approval given to this apparatus if as a result it ceases to comply with BS6301: 1989.

The Integral OTU apparatus is intended for use when supplied with power from a source with the following characteristics: +5 V (2.2 A), +24 V (250 mA). Ensure that the power drawn by the Integral OTU together with any other auxiliary apparatus drawing power from the host lies within the rating of the host power supply.

This apparatus is **NOT** suitable for connection to the PSTN or to circuits with British Telecommunications signalling at a nominal frequency of 2280 Hz. It is not intended that there shall be any DC interaction between this apparatus and British Telecommunications private circuits, nor does this apparatus use the frequency range DC to 200 Hz.

The approval of this apparatus for connection to British Telecommunication Private Speechband circuits is **INVALIDATED** if the apparatus is subject to any modification in any material way not authorised by STC.

All apparatus connected to this modem and thereby connected directly or indirectly to British Telecommunication Private Speechband circuits must be approved apparatus defined in Section 16 of the British Telecommunication Act 1981.

The Siemens TC12 Instation 667/1/22600/ETC, TC12 Freestanding OTU/LMU 667/1/22670/ETC and TC12 Integral OTU 667/1/21611/100 are CE marked and self certified to Directive 99/5/EC R&TTE.

This Handbook must be supplied with the apparatus. Validity of the approval depends on this information being supplied including the User Guide in the General Handbook 666/HB/43100/000.

TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	PURPOSE	1
1.2	SCOPE	1
1.3	RELATED DOCUMENTS	1
1.3.1	Parent Documents.....	1
1.3.2	Kindred Documents.....	1
1.3.3	Reference Documents.....	1
1.4	DEFINITIONS	1
1.5	ISSUE STATE AND AMENDMENTS.....	2
1.6	TC12 SYSTEM OVERVIEW	4
2	TC12 INSTATION.....	10
2.1	SPECIFICATION	10
2.1.1	Mains voltage ranges	10
2.1.2	Mains frequency range.....	10
2.1.3	Mains current	10
2.1.4	Temperature and humidity requirements.....	10
2.1.5	Size and Weight	11
2.2	INSTALLATION	12
2.2.1	Cabinet.....	12
2.2.2	PC	13
2.2.3	Systems Fault Indication Panel (SIP)	22
2.2.4	19" Racking PCBs.....	22
2.2.5	Digital Output Rack, PCBs and PSUs	36
2.2.6	PSTN Modem.....	39
2.2.7	External Cables	39
2.3	COMMISSIONING	44
2.3.1	Safety Tests on the TC12 Instation	44
2.3.2	Commissioning Procedure after Power Up	46
2.4	MAINTENANCE	47
2.4.1	Status LEDs	47
2.4.2	Effect of Incorrect Switch Settings on the PSU PCB	48
2.4.3	Effect of Incorrect Switch Settings on the Modem PCB.....	49
2.4.4	Effect of Incorrect Switch Settings on the Transformer PCB	50
2.4.5	Effect of Incorrect Switch Settings on the Digital Output PCBs	50
2.4.6	Fault Finding at the Instation	50
2.4.7	Replacing Modem, Transformer and Digital Output PCBs	52
2.4.8	TC12 Instation PC Help / Diagnostic Screens	52
2.4.9	Fuses	59
2.4.10	PSU	60

2.4.11	Digital Output PCB	61
2.4.12	Recommended Spares.....	61
3	TC12 OUTSTATION.....	62
3.1	SPECIFICATION	62
3.1.1	Mains voltage ranges	62
3.1.2	Mains frequency range.....	62
3.1.3	Mains current	62
3.1.4	Temperature and humidity requirements.....	62
3.1.5	Size and Weight	62
3.1.6	Detector Power Supply.....	62
3.2	INSTALLATION	62
3.2.1	General	62
3.2.2	Configuring the Outstation PCB	63
3.2.3	Connectors and Cables	69
3.2.4	Lamp Monitor Unit Connections	78
3.2.5	Current Transformer Ratings.....	80
3.2.6	Lamp Monitor Unit - Number of Current and Voltage Sensors	83
3.2.7	TC12 Outstation Mechanical Modules and Number of Detectors Supported	85
3.3	COMMISSIONING	86
3.3.1	Safety Tests on the TC12 Outstation	86
3.3.2	Commissioning Procedure after Power Up	87
3.3.3	Configuration Using the Handset.....	88
3.3.4	Examples of Lamp Monitor Unit Configuration Using the Handset.....	117
3.3.5	TCSU TC12 OTU Commissioning Procedure	128
3.4	MAINTENANCE	130
3.4.1	Status LEDs	130
3.4.2	Effect of Incorrect Switch Settings on the OTU PCB.....	132
3.4.3	Fault Finding at the Outstation	132
3.4.4	Fuses	133
3.4.5	Lithium Battery	133
3.4.6	PSU	133
3.4.7	Recommended Spares.....	135
4	TC12 INSTATION TEST SET.....	136
4.1	SPECIFICATION	136
4.1.1	Mains voltage and frequency ranges.....	136
4.1.2	Mains Current.....	136
4.1.3	Size and Weight	136
4.2	INSTALLATION	137
4.2.1	Setting the Working Voltage Range Of the Instation Test Set.....	137
4.2.2	TC12 Instation Test Set Software Installation	137
4.2.3	Error Messages during Test Set Software Start Up	137
4.2.4	Terminal Emulation Software	138
4.2.5	Installation of Handset Software.....	138

4.3	OVERVIEW OF THE TC12 INSTATION TEST SET SETTINGS/SELECTIONS AND CONNECTIONS.....	139
4.3.1	Introduction	139
4.3.2	Connection to Unit Under Test	139
4.3.3	Front Panel Switches	140
4.4	OVERVIEW OF TEST SET SOFTWARE SETTINGS/SELECTIONS AND OPERATION	143
4.4.1	Modes of Operation.....	143
4.4.2	Screens / Functions of the ITS	143
4.5	USING THE TEST SET FOR FAULT FINDING ON TC12 SYSTEM	145
4.5.1	General	145
4.5.2	Starting up the Test Set.....	145
4.5.3	Fault Diagnosis.....	146
4.6	USING THE TEST SET AS A MONITOR FOR THE INSTATION PC.....	152
4.7	USING THE TEST SET AS HANDSET	153
4.8	MAINTENANCE OF INSTATION TEST SET	154
4.8.1	Recommended Spares.....	154
4.8.2	Periodic Testing.....	154
5	TC12 OUTSTATION TEST SET.....	155
5.1	SPECIFICATION	155
5.1.1	Mains voltage and frequency ranges.....	155
5.1.2	Mains Current.....	155
5.1.3	Size and Weight	155
5.2	USING THE OUTSTATION TEST SET	156
5.2.1	Facilities	156
5.3	OPERATION.....	161
5.3.1	General	161
5.3.2	OTU Mode (Simulating an Outstation)	161
5.3.3	Controller Mode (Simulating Traffic Control Equipment)	162
5.4	MAINTENANCE.....	164
6	INTEGRAL OUTSTATION TRANSMISSION UNIT (OTU/LMU).....	165
6.1	GENERAL OVERVIEW	165
6.2	SPECIFICATION	166
6.2.1	Mains voltage and frequency ranges.....	166
6.2.2	Mains Current.....	166
6.2.3	Temperature and Humidity Requirements.....	166
6.2.4	Size	166
6.3	INSTALLATION	167

6.3.1	General	167
6.3.2	Configuring the Integral OTU PCB	167
6.3.3	Connectors and Cables	170
6.3.4	Lamp Monitor Unit - Number of Current and Voltage Sensors	176
6.4	COMMISSIONING	177
6.4.1	Commissioning Procedure after Power Up	177
6.4.2	Configuration Using the Handset.....	178
6.4.3	Examples of Lamp Monitor Unit Configuration Using the Handset.....	183
6.4.4	LMU Commissioning	186
6.5	MAINTENANCE	189
6.5.1	Status LEDs	189
6.5.2	Effect of Incorrect Switch Settings on the OTU PCB.....	189
6.5.3	Fault Finding at the Outstation	190
6.5.4	Lithium Battery	190
6.5.5	Recommended Spares.....	190

FIGURES

FIGURE 1 - SYSTEM DIAGRAM FOR DIGITAL OUTPUT RACK CONNECTION TO A WALL MAP	8
FIGURE 2 - SYSTEM CONNECTION FOR TWO ITU RACKS	9
FIGURE 3 - TC12 CABINET - EXTERNAL DIMENSIONS	11
FIGURE 4 - TC12 INSTATION PC INSTALLATION SCREEN (7.4)	19
FIGURE 5 - TC12 INSTATION PC INSTALLATION SCREEN (8.3 & LATER).....	19
FIGURE 6 - ITU 19" RACK (FRONT VIEW)	22
FIGURE 7 - PSU BOARD LAYOUT	25
FIGURE 8 - PSU BOARD SWITCH SETTINGS.....	26
FIGURE 9 - PSU BOARD MAINS VOLTAGE RANGE SETTING	27
FIGURE 10 - MODEM PCB LAYOUT	30
FIGURE 11 - TRANSFORMER PCB LAYOUT.....	35
FIGURE 12 - ITU 19" RACK (REAR VIEW)	35
FIGURE 13 - DIGITAL OUTPUT PCB LAYOUT.....	36
FIGURE 14 - MODEM PCB - MDF CONNECTIONS	41
FIGURE 15 - TRANSFORMER PCB - MDF CONNECTIONS.....	43
FIGURE 16 - MODEM AND PSU PCB STATUS LEDS.....	48
FIGURE 17 - MASTER SWITCH PANEL FUSES	60
FIGURE 18 - OUTSTATION PCB LAYOUT	64
FIGURE 19 - OUTSTATION PCB AND DAUGHTER BOARD LAYOUT	64
FIGURE 20 - OTU LITHIUM BATTERY ON / OFF SWITCH (S2)	67
FIGURE 21 - OTU 2/4 WIRE SELECT SWITCH (S4)	67
FIGURE 22 - OTU 600 Ω HIGH IMPEDANCE SWITCH (S6).....	67
FIGURE 23 - MODEM DAUGHTER CARD JUMPER POSITIONS.....	68
FIGURE 24 - OTU 6-WAY TELECOM SOCKET CONNECTIONS.....	70
FIGURE 25 - OUTSTATION INPUT CONNECTIONS.....	73
FIGURE 26 - OUTSTATION OUTPUT CONNECTIONS.....	74
FIGURE 27 - FREESTANDING OUTSTATION INPUTS.....	76
FIGURE 28 - LMU INPUT CONNECTOR.....	78

FIGURE 29 - PHASES IN STAGES FOR EXAMPLE 6	125
FIGURE 30 - OUTSTATION PCB STATUS LEDS	131
FIGURE 31 - OUTSTATION PSU VOLTAGE CHECKS	134
FIGURE 32 - OUTSTATION TEST SET FRONT PANEL	157
FIGURE 33 - OUTSTATION TEST SET CONNECTIONS	158
FIGURE 34 - INTEGRAL OTU PCB LAYOUT AND SWITCH SETTINGS	168
FIGURE 35 - LMU INPUT CONNECTOR	173

TABLES

TABLE 1 - MODEM PCB MODE SELECT SWITCH (SW1)	31
TABLE 2 - MODEM PCB LINE LEVEL SWITCHES (SW2, 3, 6 AND 7)	32
TABLE 3 - MODEM PCB 2/4 WIRE SELECT SWITCH (SW4)	33
TABLE 4 - MODEM PCB TRANSFORMER SELECT SWITCH (SW5)	33
TABLE 5 - OTU LINE LEVEL SWITCH (S3)	68
TABLE 6 - OUTSTATION PROCESSOR PCB - PL1	79
TABLE 7 - TCSU DEFAULT CONFIGURATION VALUES	129
TABLE 8 - INTEGRAL OTU LINE LEVEL SWITCH (S3)	170
TABLE 9 - INTEGRAL OTU PLA - 40 WAY CONNECTOR	170
TABLE 10 - INTEGRAL OTU SK2 SK3 - TEST JACKS	171

1 INTRODUCTION

1.1 PURPOSE

This document is a guide for professional Installation and Maintenance personnel. It describes how to install, commission and maintain the TC12 Instation and Outstation.

1.2 SCOPE

Section 2 covers the Instation cabinet and all the equipment contained within the TC12 Instation. Section 3 covers all equipment associated with the TC12 Outstation. Sections 4 and 5 describe the Instation and Outstation test sets. Section 6 describes the integral OTU that may be fitted in T400 and ST800 controllers.

1.3 RELATED DOCUMENTS

1.3.1 Parent Documents

- a) Requirements Specification for Data Transmission System, 666/UH/43100/000 issue 5.

1.3.2 Kindred Documents

- a) General Handbook for the TC12 System, 666/HB/43100/000
- b) Handbook for the TC12 Serial Environmental Monitor Sensor interface 667/HB/26628/000.

1.3.3 Reference Documents

- a) Technical Handbook for Telecommand 8 Outstation Test Set, PTM112/01.
- b) TRRL Supplementary Report 526, Automatic Incident Detection - TRRL algorithms HIOCC and PATREG.

1.4 DEFINITIONS

IMD	Intelligent Modem Driver
ITS	Instation Test Set
ITU	Instation Transmission Unit
LMU	Lamp Monitoring Unit
MDF	Main Distribution Frame
OTS	Outstation Test Set
OTU	Outstation Transmission Unit
PITS	Portable Intelligent Terminal System
PC	Personal Computer
STC	Siemens Traffic Controls
TCC	Traffic Control Computer
UTC	Urban Traffic Control

1.5 ISSUE STATE AND AMENDMENTS

Issue 1 - First formal issue

Issue 2 - Significant changes this issue are listed below:

Table 3 and Table 6 Modem PCB and OTU PCB Receive threshold switch settings for -39 dBm and -33 dBm were reversed in issue 1.

Instation recommended spares, PSU PCB and PSU added.

Modem PCB, Transformer PCB and OTU PCB all have covers - the part numbers have been corrected.

Section 5 Outstation Test Set - connections have been corrected (Figure 27 updated), there are now 6 cableforms 666/1/22658/000 to 005.

Section on Outstation Test Set Controller Mode - Corrected OTS switch function and LED indicator function in this mode.

Safety Tests on the TC12 Instation - updated to say that if rack or panel is removed then earth continuity must be rechecked. PSU PCB OV added to earth continuity tests.

Safety notes added in various places to state that only authorised/trained personnel can access behind the doors/panels on the TC12 Instation.

PSU PCB Installation updated to include connection of an earth strap.

OTU Telephone connections updated since cable is terminated in a plug. Note added about ferrite core being cable tied to stop it moving/interfering.

Instation PC Software Installation section and PC card switch settings updated.

Instation software - IMD information screen, layout of information corrected.

Modem PCB switch settings clarified (Figure (8) and Tables 2,3 and 5)

Paragraph added to Modem PCB section to clarify IMD distribution module connections.

LMU Information Expanded and corrected:

Red Lamp monitoring has not been approved by the Department of transport and should not be used.

Maximum Number of signal heads for current transformers updated, including information on 50-0-50 operation.

Voltage sensors can only be used down to first dim tap when monitoring 50-0-50 supplies.

LMU input 24 is commoned with the ZXO (voltage monitor input).

Section added on the number of current and voltage sensors required.

Section added showing examples of LMU handset configuration.

- Section added on LMU Commissioning.
- Handset commands updated - GSA, GUD, GDI, KDI, KMS, KFD, KAD, KPT, KRE, KLS.
- New handset commands added - KLV and GLT.

Issue 3 - Significant changes for this issue listed below.

Section 6 added, contains details of the Integral OTU - Export only.

Handset commands for High Occupancy software (HIOCC) added:

GHA, GHZ, GHV, GHL, GHN, GHF, and GHE.

New functions for HIOCC added to GRL command.

Setting up the 600R / High Impedance switch. Instructions now allow for Multi-drop line configuration. Agreement with BABT or other line supplier to be sought before use.

Example of lamp monitoring on a more complex junction added.

Drawing of OTU input, and reply bytes added.

Replacement current sensor part number added. (667/7/25171/000)

- Replacement voltage monitoring transformer part number added. (667/7/25172/000)

Issue 4 - Significant changes for this issue listed below.

- Handbook converted to Word v6.
- 667/HB/26628/000 OTU Serial Environmental Monitor handbook added.
- Remote Handset details added.
- OTU default values for TCSU added.
- OTU Handset commands GPV, KPV, GIU, KCF, KFS, KEV, KEL, GDO, GDT, KML, GOT and KLP added.
- OTU Handset command GCT updated.
- Table 2 corrected.
- Additional Phase types added to handset commands KMS and KPT.

Issue 5 - Significant changes for this issue listed below.

- Cross references resolved
- Headers and footers updated
- Spelling corrected
- References to VAX changed to UTC TCC
- References to T400 changed to reflect addition of ST800 Controller
- Table 1 rewritten
- Table 2 amended
- 2.2.2.1 to 2.2.2.5 rewritten
- 3.3.3.4 amended
- 3.3.3.10 note added
- 3.3.3.24 text added
- 3.3.3.25 amended
- 6.4.2 table RFL command amended
- Figure 22 PL12 changed to PL2
- 3.2.3.5 Current Transformers and following text changed to heading 3.2.3.6 Current Transformer Ratings

Issue 6 - Significant changes for this issue listed below.

- Integral OTU now has BABT approval (leased line) and consequential changes are:
 - 6.1 amended
 - 6.2.1.amended
 - 6.3.1.amended
 - 6.3.2.3 amended
 - Table 8 amended to show prohibited power level settings
- Figure 1 and 2 redrawn (deleted in error from previous issue)

Issue 7 - Significant changes for this issue:

- Equipment is CE marked and self-certified to RTE Directive 99/5/CE R&TTE. BABT approval no longer appropriate. References to BABT removed throughout document.
- Clarification to battery change procedures, sections 3.4.5 and 6.5.4.
- Instation Power Supply replacement procedure added to section 2.4.10.
- General updates to formatting and spelling.
- Preface removed, since the information it gave is available from the table of contents.

Issue 8 - Significant changes for this issue:

- Changes to reflect introduction of RS232 OTU communications interface.
- Instation software installation procedure revised

Issue 9 - Significant changes for this issue (July 2004):

- Changed OTU PCB part number to /100 from /001 and added Integral OTU kit part number to section 6.5.5.
- Added TC12 inputs specification to section 3.2.3.5.
- Edited section 3.4.1 – Status LEDs.
- Added codes 83-91 to Function Group 1 of Display Fault Data section 3.3.3.28.

1.6 TC12 SYSTEM OVERVIEW

TC12 is a telecommunications system designed for Urban Traffic Control (UTC). It consists of a number of Outstation Transmission Units (OTUs) positioned in the traffic controllers or detector cabinets. These communicate with a central office containing a number of Instation Transmission Units (ITUs). Communication between the two is by means of private wire telephone lines, which can be operated at different baud rates and signal levels.

The ITU sends a Control message to the OTU that will cause the OTU to form the appropriate Reply message, which it will send back. These messages are of configurable size depending on the amount of data transfer needed.

The ITU connects to a Traffic Control Computer (TCC) system consisting of one or more UTC TCC computers and one or more PCs communicating with each other via an Ethernet link. This system drives the ITU modems, which communicate with the OTU via the telephone lines.

The ITU also drives the System Fault Indication Panel (SIP) which indicates, by means of LEDs and an audible alarm, failures in the TCC. The SIP is housed in the ITU cabinet but there is also the option of driving a remote SIP. The ITU can also be used to drive a TC8 Instation.

There is also facility for an Instation Test Set which can be used to measure signal levels and monitor communications (both data and errors) on the telephone lines. It can also be used to take the place of either Instation or Outstation for testing.

The Outstation test set is used in place of the controller to both set Reply bits and monitor Control bits at the OTU.

Instation

The Instation comprises of one or more Traffic control computers (TCC) and one or more Instation Transmission Units (ITUs). The ITU cabinets are 32U high with grey panelling and a smoked glass front door.

Traffic Control Computer

The TCC is a system containing a minimum of one machine and one PC per ITU cabinet. The UTC TCC system communicates with the PC(s) via an Ethernet link. More than one UTC TCC will be used should the number of modems required demand it.

Instation Unit

The ITU cabinet is fitted with a PC at the top, and space for up to four racks below it. These racks will be either ITU or Digital output racks, but the bottom space can be used for an OTU if required. There is also a mains distribution system with spare sockets, and facility for mounting a PSTN modem that would connect to the UTC TCC to allow remote interrogation.

System Fault Indication Panel

The System Fault Indication Panel (SIP) is positioned in front of the PC and houses LEDs to warn of various failures. There is also an audible alarm on the SIP that can be cancelled by a switch next to it or disabled by a switch on the PSU board.

ITU Rack

A full ITU rack contains three types of board; four modem boards, four transformer boards and a power supply board.

The modem board has four modem chips that communicate with the PC via a V.24 link. These modems are connected to the OTU via the telephone lines in either radial, multidrop or multipoint format. There is also a pair of test jacks on the modem board to allow connection to the Instation test set to monitor communications data and measure signal levels.

The transformer board is used, when the system is in radial configuration, to split each modem to up to eight telephone lines. This gives a maximum of 128 telephone lines per rack.

The PSU board supplies power to the ITU rack. It also interfaces between the PC and the SIP and allows connection to a TC8 ITU rack. This facility would be used should a TC8 system be expanded with TC12.

Digital Output Rack

The Digital output rack contains one Instation rack Power Supply Card and between one and sixteen Digital Output boards, each capable of driving 64 LEDs at up to 30 V 25 mA. There are two variants of Digital Output board, one sources current and the other sinks current. The system could be used for any application requiring digital output, not just wallmap driving.

Instation Test Set

The Instation Test Set (ITS) is housed in an attaché case, and connects to either the Modem PCBs or the OTU PCBs. It contains a PC, a modified ITU modem board, an ITS logic board and two power supplies. One power supply is the same unit as on the PSU board in the ITU rack and is used to power both the boards, whilst the other is the PC PSU. The ITS provides for connection to the Modem or OTU board as well as use as a handset.

Outstation Test Set

The Outstation test set is a portable unit housed in a small grey metal case. It requires a mains supply for operation and two cable forms with which to interface with the OTU being tested.

Freestanding Outstation

The freestanding outstation is a rack that can be bolted into any Traffic Controller. It contains a Power Supply, an OTU PCB and up to four detector PCBs. Two connectors allow the OTU inputs and outputs to be wired up to the controller and or detector cards, and the OTU is delivered with a cable for this purpose. The outstation can also provide an LMU facility, and a connector allows current and voltage monitoring transformers to be attached for this purpose. There is a pair of test jacks on the board to allow connection to the Instation test set to monitor communications data and measure signal levels.

Figure 1 and Figure 2 show diagrams of example system connections.

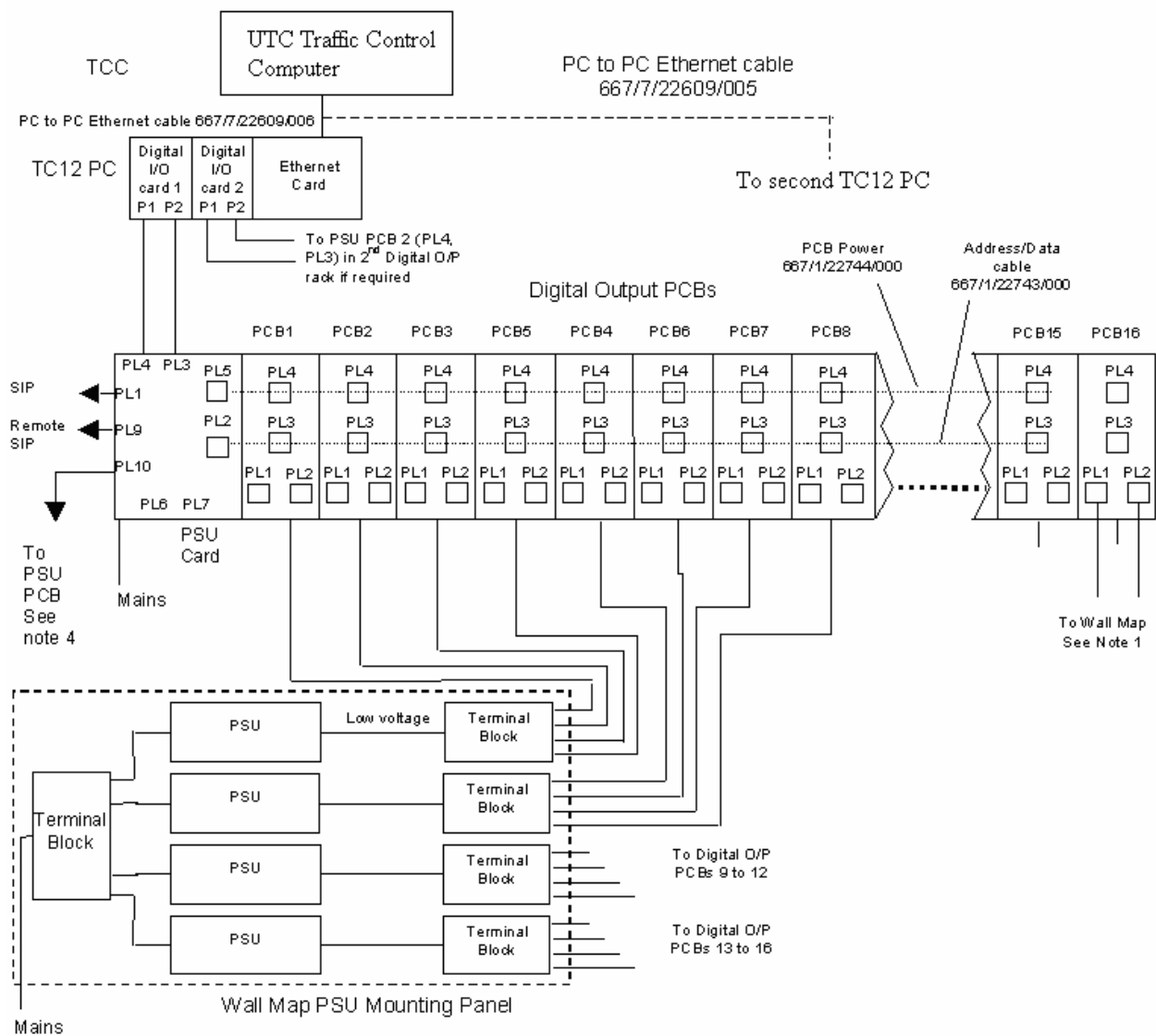
Integral OTU

The integral OTU is a printed circuit card that can be installed in a T400 or ST800 Traffic Controller. It is a version of the T400 Ancillary processor with suitable firmware to configure it to be an OTU. A single 40-way ribbon cable connector supplies communication to the controller and all power. A 60 way ribbon cable connector is fitted for connection to current and voltage monitoring transformers for use as an LMU. There is no provision for detector inputs - the controller supplies all detector information.

Connection to the line is via a captive lead terminated in a 6-way BT plug.

There is a pair of test jacks on the board to allow connection to the Instation test set to monitor communications data and measure signal levels.

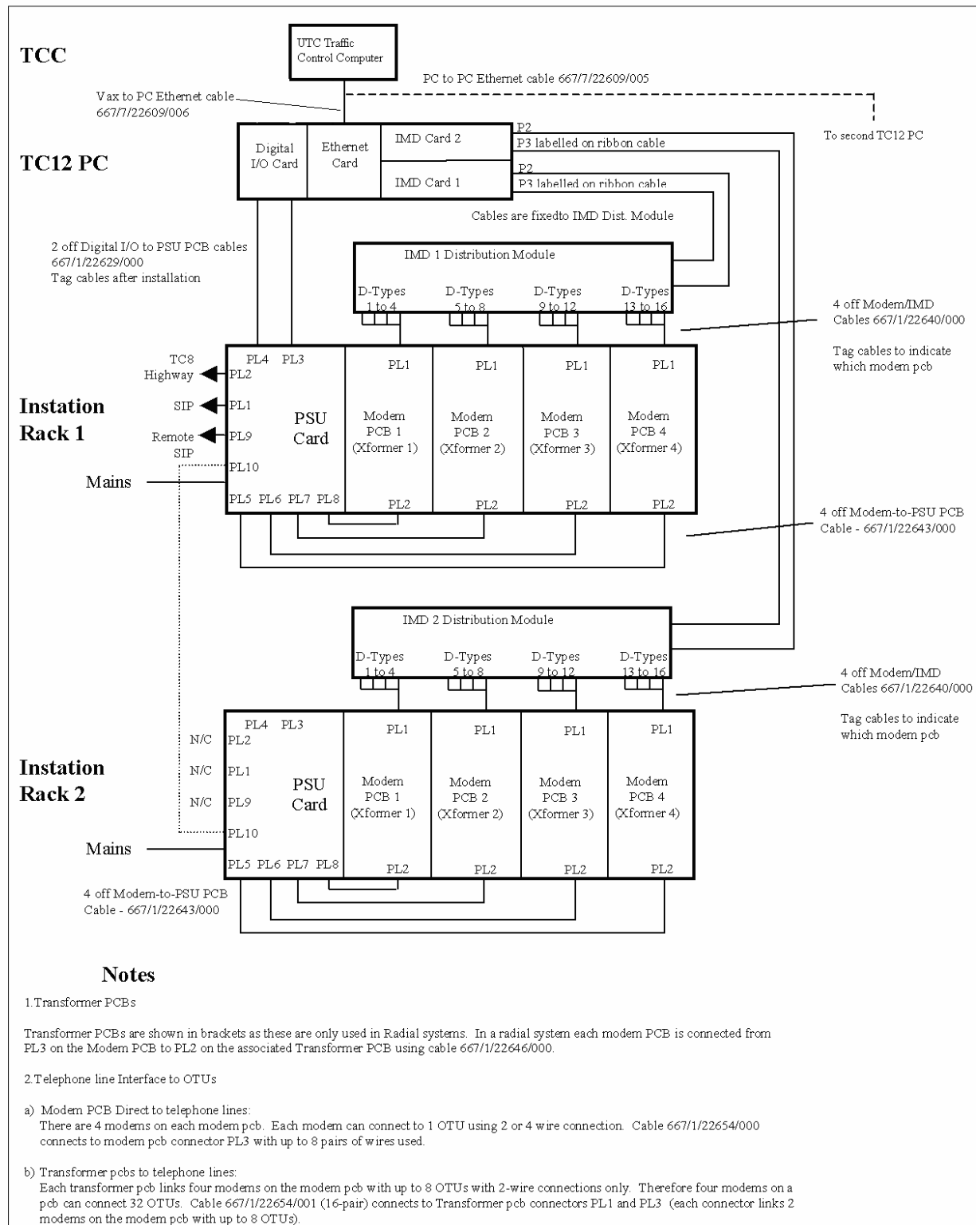
Figure 1 - System Diagram for Digital Output Rack connection to a Wall Map



Notes

1. PL1 and PL2 on each Digital O/P PCB provide 4 off Vcc and 4 off Gnd O/P power pins on both connectors. These originate from the wall map Power Supplies connected to PL5 of each PCB. PL1 and PL2 also provide 32 digital O/P pins. If the Digital O/P PCBs are current source variants connect Vcc to the common of each LED. The other pins of the LED connect to the digital O/P pins of the same connector that Vcc or Gnd come from.
2. If a second Digital O/P rack is included in the same cabinet, a second digital I/O Card is fitted to the PC as shown above. A second wall map mounting panel can be included in the installation cabinet, again with 4 power supplies. Connections are as for the first digital output rack except that the PCB card in the second rack would not connect to the SIP or the Remote SIP.
3. The number of digital O/P PCBs connected to one wall map power supply is shown as four on the diagram. This will vary depending on the amount of current the digital outputs need to supply. The power supplies may be fitted external to the cabinet.
4. To PSU PCB Connector PL10 if an ITU rack is also included in the cabinet. PSU to PSU cable is 667/1/22655/000. In this case an IMD Card is required in the PC and an IMD Distribution Module.

Figure 2 - System Connection for two ITU Racks



2 TC12 INSTANTION

2.1 SPECIFICATION

2.1.1 Mains voltage ranges

The Instation will work over: 98 – 132 V RMS
198 – 264 V RMS

Note. The voltage range of the PC used in the Instation should be checked in the manufacturer's literature and note should be taken of any links/switches that need setting for different voltage ranges.

2.1.2 Mains frequency range

All TC12 equipment will work from 47 Hz to 63 Hz

2.1.3 Mains current

Instation Cabinet and PC without racks 1.0 A @ 240 V

ITU Rack (Fully equipped) 200 mA @ 240 V

Digital Output Rack (Fully equipped) 4.5 A @ 240 V
1024 LEDs at 24 V 25 mA per LED

Digital Output Rack (Fully equipped) 2.75 A @ 240 V
1024 LEDs at 24 V 15 mA per LED

The figures above are added together for the system used:

An ITU cabinet with two ITU racks will use:
 $1.0 + 0.2 + 0.2 = 1.4 \text{ A}$

An ITU cabinet with two 15mA Digital output racks will take:
 $+ 2.75 + 2.75 = 6.5 \text{ A}$

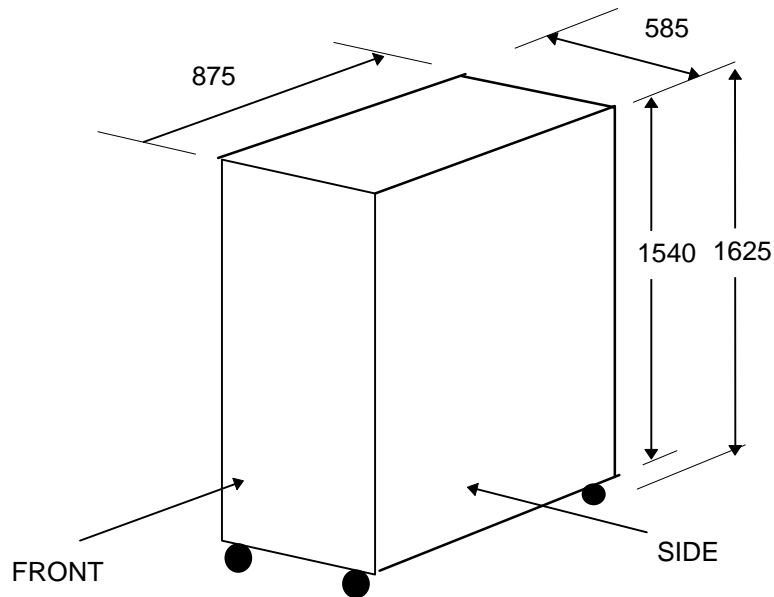
2.1.4 Temperature and humidity requirements

The ITU will work over: 0 °C to 40 °C

Humidity: 20%-80% non-condensing

2.1.5 Size and Weight

Figure 3 - TC12 Cabinet - External Dimensions



All dimensions in mm

Weight:

Cabinet 111 Kg

ITU Rack 8.4 Kg

Digital Output Rack 8.3 Kg

Note: The weight of the cabinet does not include any of the PC equipment, and the weights specified for the racks are with their full complement of PCBs.

2.2 INSTALLATION

Safety Notes on TC12 Instation

Only authorised/trained personnel are allowed to have access behind the doors/panels of the TC12 Instation Cabinet. Users/operators must not attempt to access anything behind these doors/panels.

Only an authorised/trained person (trained in the safety aspects of working on mains powered equipment, is allowed to setup/change any switch positions in the Instation equipment and/or use any of the free mains sockets within the equipment and/or connect/use the TC12 Instation Test Set at the Instation.

If the Audible alarm on the system fault indication panel (SIP) sounds it should be cancelled as required from the UTC TCC terminal. If the reason for the alarm is a UTC TCC failure, an authorised/trained person (trained in the safety aspects of working with mains powered equipment), should be asked to cancel the audio alarm, using the audio off switch on the PSU PCB.

On site safety tests, as described in section 2.3.1, must be carried out before the Instation is attached to the mains. If after the on site earth continuity test, any rack or panel is removed or replaced, then the earth continuity check to that item should be repeated.

2.2.1 Cabinet

The TC12 Family Tree part number is 667/DZ/22600/000. This shows the structure of part numbers within the TC12 system. The top-level part number for the TC12 Instation is 667/1/22600/000.

The racking space is 32U high, and contains five 6U positions and one 2U position, refer to drawing 667/GA/22600/000 which shows the position of the major components fitted to the cabinet. These include:

Master Switch Panel Assembly fitted to rear of cabinet, height 2U
(667/1/22603/000)

Mains Socket Assembly, fitted to front of cabinet, height 2U (667/1/22605/000)

System Fault Indication Panel (FIP), height 6U (667/1/22667/000)

TC12 PC Mounting Chassis (667/2/22621/000)

IMD Distribution Mounting Panel (667/2/22636/000)

Additionally 1 or more TC12 19" Instation Racks (height 6U, refer to separate drawing 667/GA/22626/000) will be fitted - these contain PSU PCBs, Modem PCBs and possibly Transformer PCBs, all of which are described in later sections.

The Instation may contain 19" Digital Output Racks (height 6U, refer to drawing 667/GA/22626/001) as well as, or instead of TC12 19" Instation Racks.

Optionally a TC12 Outstation can also be fitted to the Instation cabinet, for test purposes. The Outstation is 5U high and therefore, if fitted, a 1U blanking panel is also included (667/1/22613/000)

Unused 6U positions are fitted with a 6U blanking panel (561/4/20899/022)

2.2.2 PC

The TC12 PC is not like most PCs in that it does not have a motherboard; instead the processor card and the other cards are plugged into a back plane. There are 2 types of TC12 PC which may be used and are described below:

2.2.2.1 Rack Mount PC

The Rack Mount PC is a convention desktop style of PC which sits on a shelf in the TC12 cabinet. It has a conventional keyboard attached to it and needs a separate monitor for software installation and any checking of its operation.

2.2.2.2 Flat Panel PC

The Flat Panel PC may be used in situations where a compact TC12 Instation is required. The PC is normally mounted in a 19" rack and has an integrated LCD screen and membrane keyboard.

2.2.2.3 TC12 PC Operating System

The TC12 PC software uses DOS as its operating system. The TC12 PC normally comes with DOS pre-installed. If, however, if DOS is not installed then the PC manufacturer's set up instructions should be followed.

SAFETY NOTE!

When initialising the PC, check the working voltage range of the PC is suitable for the mains supply that is going to be used. Follow the manufacturer's instructions for any switches/links etc., which need to be changed in order for the PC to work with the intended mains supply.

2.2.2.4 TC12 PC Configurations

The following combinations of TC12 PC may be used:

2.2.2.4.1 Rack Mount Data Transmission PC

A rack mount PC which is to be used for data transmission would normally have the following, additional, cards installed in it.

- Ethernet Card (Etherlink 3) (not needed if processor card has built-in Ethernet)
- Digi I/O Card
- Intelligent Modem Driver Card (IMD) either Xi or Xe (1 per ITU rack)

2.2.2.4.2 Rack Mount Wall Map PC

A rack mount PC which is to be used for driving the LEDs on a wall map would normally have the following, additional, cards installed in it.

- Ethernet Card (Etherlink 3) (not needed if processor card has built-in Ethernet)
- Digi I/O Card (1 per digital output rack)

2.2.2.4.3 Flat Panel Data Transmission PC

A flat panel PC which is to be used for data transmission would normally have the following, additional, cards installed in it.

- Digi I/O Card
- Intelligent Modem Driver Card (IMD) Xem.

2.2.2.5 3Com Etherlink 3 Ethernet Card Set Up

The Ethernet card (part number 667/7/22609/014) needs a half slot in the PC; a full slot can be used if there are no half slots available.

The setting up of a 3Com Etherlink 3 card is described below. There are no links or jumpers on the card and the set up is performed using a configuration program. With the Ethernet card installed in the PC, the PC booted up and at the C: DOS prompt The TC12 software installation disk should be inserted into the PC's floppy drive and the following command used to run the set up program:

A:\ELNK3\3C5X9CFG.EXE

The set up part of the program to set the parameters listed below to the values shown:

Plug and Play	Disabled
I/O Base Address	300H
Interrupt Request Level	3
Transceiver type	Auto Select
Network Driver Optimisation	DOS Client

Note: If Plug and Play is enabled, this should be disabled first, the configuration saved and the PC rebooted before any other settings are changed.

2.2.2.6 UM9008 On-Board Ethernet Set Up

Where the processor card has a built-in Ethernet controller (UM9008) the UM9008 configuration and diagnostic utility program should be run before any boards are installed in the PC. To run the program the TC12 software installation disk should be inserted into the PC's floppy drive and the following command used to run the diagnostic utility program:

A:\UM9008\DIAG9008.EXE

The first screen of the DIAG9008 program shows the current configuration with the options of Accept and Exit, Diagnostics, or Configuration. To change the configuration, select Configuration, followed by Modify Configuration. The arrow

keys are then used to select the items to change; only the Interrupt Request Level and the Base Address can be changed. The parameters should be set to the values shown below:

I/O Base Address 300H
Interrupt Request Level 3

Note: If an Etherlink 3 card is to be used in a PC with a built-in Ethernet connection the Etherlink 3 card settings must be those in 2.2.2.5; The UM9008 settings of Interrupt Request Level and the Base Address must be changed to be different from those of the Etherlink 3 card, choosing values which do not conflict with those required for the IMD cards and the DIGI I/O card.

2.2.2.7 Digi I/O card and cables

This Digi I/O card (part number 667/7/22609/004, PCDIO48-P needs a half slot in the PC; a full slot can be used if there are no half slots available.

The various blocks of jumpers on the board should be set as follows:

Jumper	Setting
JP1	The N/A jumper, only, should be bridged
JP2	No jumpers should be fitted
JP3	All Jumpers should be set to position B
JP4	All Jumpers should be set to position B
JP5	All Jumpers should be set to position B

The address of the board(s) should be set using S1, the Base Address DIP switch, as follows:

Board Number	Address
1	320H
2 (if required)	328H

The corresponding address switch settings are:

A9	A8	A7	A6	A5	A4	A3	A2	Address	Board
OFF	OFF	ON	ON	OFF	ON	ON	ON	320H	1
OFF	OFF	ON	ON	OFF	ON	OFF	ON	328H	2

The switch positions are labelled to indicate which switch corresponds to A2 through to A9. A label also indicates what position the switches should be in for ON

Two 50-way ribbon cables (part number 667/1/22629/000) are used to connect the Digi I/O card to the PSU board in the ITU rack:

One cable is attached from the connector labelled J1 or P1 on the DIGI I/O Card to connector PL4 on the PSU board, (the PSU board has a note on the silk screen next to PL4 which reads 'CONNECTION TO P1 DIGI I/O (PC)').

The second cable is attached from the connector labelled J2 or P2 on the DIGI I/O Card to connector PL3 on the PSU board, (the PSU board has a note on the silk screen next to PL3 which reads 'CONNECTION TO P2 DIGI I/O (PC)').

Note: The two 50-way ribbon cables are to be connected to the card before it is installed into the PC.

WARNING Please ensure cables are connected correctly, as they are not polarised. After installation the cables should be labelled to show which is connected to P1 and which is connected to P2.

2.2.2.8 IMD cards and cables

There are 3 different types of IMD cards and distribution unit which have been used in TC12 Instations. Their differences and installation is described below:

2.2.2.8.1 DIGI PC/16i

The DIGI PC/16i comprises a full length ISA card (DIGI part number 50000160) and an IMD Distribution Unit (labelled PC/16I I/O MATE INTERFACE). The PC board has 3 jumpers (J1, J2 and J3) and 2 DIP switches (DS1 and DS2).

The 3 jumpers are used to set the local program memory size, which should be 64K. Each of the 3 jumpers has 3 pins which are numbered from top to bottom. Each jumper should be set so that pins 2 and 3 are bridged.

Set the address of the dual-ported RAM to E0000 using DIP switch 1 (DS1) positions 1 to 8, as shown below:

<u>Address</u>	<u>SW1</u>	<u>SW2</u>	<u>SW3</u>	<u>SW4</u>	<u>SW5</u>	<u>SW6</u>	<u>SW7</u>	<u>SW8</u>
E0000	ON	OFF	OFF	OFF	ON	ON	ON	ON
D0000	OFF	ON	OFF	OFF	ON	ON	ON	ON
A0000	ON	OFF	ON	OFF	ON	ON	ON	ON

[ON = PUSH SWITCH DOWN]

If, when the program is run, an address error is reported, the next available address from the three listed above, should be tried.

If, more than one IMD board is installed in a TC12 PC, the address of the dual-ported RAM on each board be set the same.

Set the I/O Port addresses of the boards using DIP switch 1 (DS1) positions 9 to 11, as shown below:

<u>Board</u>	<u>SW9</u>	<u>SW10</u>	<u>SW11</u>	<u>Address</u>
1	ON	OFF	OFF	0x100
2	ON	ON	OFF	0x120
3	OFF	OFF	ON	0x200
4	ON	OFF	ON	0x220

Set the interrupts using DIP switch 2 (DS2), positions 1 to 8, as shown below:

<u>Board</u>	<u>SW1</u>	<u>SW2</u>	<u>SW3</u>	<u>SW4</u>	<u>SW5</u>	<u>SW6</u>	<u>SW7</u>	<u>SW8</u>	<u>Interrupt</u>
1	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	IRQ5
2	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	IRQ11
3	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	IRQ15
4	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	IRQ7

2.2.2.8.2 DIGI AccelePort 16e

The DIGI PC/16i comprises a full length ISA card (DIGI part number 60000200) and an IMD Distribution Unit (labelled Digi AccelePort 16e ISA DB25M RS232). The PC board has a single jumper (J1) and 2 DIP switches (DS1 and DS2).

The jumper is used to set the local program memory size, which should be 64K. The jumper has 3 pins which are numbered from left to right. The jumper should be set so that pins 2 and 3 are bridged.

The setting of the 2 DIP switches, DS1 and DS2, is the same as for the DIGI PC/16i board (See 2.2.2.8.1).

2.2.2.8.3 DIGI AccelePort Xem

The DIGI AccelePort Xem comprises a three quarter length Xem ISA Host Adapter (419/4/95931/000 - DIGI part number 77000211), a 16em DB25 Module (653/4/05229/000 - DIGI part number 76000073) and a Xem 5ft Cable (707/4/08514/000 - DIGI part number 62080060). Each 16em DB25 Module is supplied with a short cable which enables a maximum of 4 16em DB25 Modules to be daisy chained together. Two 16em DB25 Modules may be powered from the ISA Host Adapter. Additional Modules require auxiliary power supplies (605/4/08678/000 - DIGI part number 76000321).

The PC must be powered off before the Xem host adapter card is installed. The PC should remain off until the 16em DB25 Modules have been connected to the host adapter. The only set up required on the Xem host adapter is to set the I/O port address to 124H-127H using DIP switch DS1

<u>Address</u>	<u>SW1</u>	<u>SW2</u>	<u>SW3</u>	<u>SW4</u>
124H-127H	OFF	ON	ON	ON

2.2.2.9 IMD Distribution Modules (16i and 16e Units)

The IMD distribution Units (part number 667/7/22609/010), which are part of the DIGI 16i and DIGI AccelePort 16e units are secured by clamps (667/2/22638/000) to the IMD Distribution Mounting Panel (667/2/22636/000, see TC12 cabinet assembly drawing 667/GA/22600/000 and TC12 IMD/Modem Panel assembly drawing 667/GA/22635/000). This mounting panel is a hinged aluminium panel at the back of the Instation. Each IMD Distribution Unit has two ribbon cables labelled P2 and P3. The other end of these ribbon cables connects to the two connectors, labelled P2 and P3, on the IMD card in the PC.

One IMD module contains 16 25-way D-type connectors. A group of four D-Connectors connect via a single 24-way cable to one modem PCB, see section 2.2.4.2. This cable provides V.24 signals from the PC to the four modems on one modem PCB.

The IMD Cables should be secured to the bottom of the hinged IMD panel.

Note: If it becomes necessary to replace either the IMD distribution box or the IMD PCB they should both be changed at the same time.

Note: Before fitting the card into the PC, the card and the distribution unit should be laid out on the bench and positions of the folds in the two ribbon cables, determined. Where the ribbon cables pass through the rear of the PC they should be strapped together with insulating tape. The card has to be fitted to the PC before the ribbon cables are finally plugged into the card.

2.2.2.10 IMD Distribution Modules (Xem Units)

The 16em DB25 Module is the wrong shape to be mounted on the hinged aluminium panel and is normally mounted on a shelf within the TC12 cabinet. A suitable shelf is a 1U Modem shelf (RS Part No 228-9441).

2.2.2.11 TC12 Instation PC Software Installation

The TC12 PC Software is supplied on a single floppy disk. There are 2 versions of TC12 software currently in use, Version 7.4 should be used if it is required to update an existing installation; Version 8.3 should be used on all new installations. The installation procedure for both software versions is basically the same, but version 8.3 has the following additional features:

- Allows a PC processor card with onboard Ethernet to be used
- An option to disable the playing of the start up tune
- An option to disable the driving of the SIP.
- The default screen display shows the state of the TCC Ethernet connection, and the System and Operational alarm states.

If the TC12 PC does not have a built-in monitor, a VGA monitor should be attached before starting the software installation process.

The software installation procedure is as follows:

SAFETY NOTE

The PC should be plugged directly into the mains, and not via the mains distribution panel on the Instation, since the Instation has not undergone on-site safety tests, described in the commissioning section, at this stage.

Figure 4 - TC12 Instation PC Installation Screen (7.4)

TC 12 INSTATION PC INSTALLATION		
Ethernet Card EtherLink II (3c503) DEPCA DEC Etherworks LC DEC Etherworks Turbo	Number of boards <div style="border: 1px solid black; text-align: center; padding: 5px; margin: 5px;">1</div>	Start Installation No Yes Quit Installation
Digital I/O boards Board #1 OK Board #2 Not Installed	IMD-DS1, SW1-8 Settings Use address 0 x E0000 <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> </div> <div style="text-align: center;"> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> 12345678... </div>	IMD boards Board #1 OK Board #2 Not Installed Board #2 Not Installed Board #2 Not Installed
Use the cursor keys ↑ or ↓ to move between selections on menu Use the cursor keys → or ← to move between menus Use Enter or Return ↵ to select		
Press Esc to exit		

Figure 5 - TC12 Instation PC Installation Screen (8.3 & later)

TC12 Instation PC Installation			
Ethernet Card Etherlink II <3C503> Etherlink 3 <3C509> Panel PC <UM9008> DEPCA DEC EtherWORKS LC DEC EtherWORKS TURBO	Tune No Yes	SIP No Yes	Comms Modem Direct/Flow Control Direct/No flow Ctrl
Install No Yes Quit			
Digital I/O boards Board #1 OK Board #2 Not installed	IMD - DS1, SW1-8 settings Use address 0xE0000 <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> </div> <div style="text-align: center;"> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> <div style="width: 10px; height: 10px; background-color: black; margin: 0 auto;"></div> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> 12345678... </div>		IMD boards #1 OK 100/5 <Xi or Xe> #2 Not Detected #3 Not Detected #4 Not Detected
Use cursor keys ↓ or ↑ to move between selections on menu, use cursor keys → or ← or tab ⇥ to move between menus use Enter or Return ↵ To select			
Press Esc to exit			

- (1) Before starting the TC12 software installation the Ethernet connection should be configured using the instructions given in 2.2.2.5 or 2.2.2.6, as appropriate.
- (2) Insert the TC12 Software disk into the PC and then switch the PC On. The Installation software will auto-boot and 'SIEMENS' will be displayed for a short time followed by the TC12 Instation PC Installation Screen, which should look something like Figure 4 if the software is Version 7.4. If the software is Version 8.3 it should something like Figure 5.
- (3) Check that the status for each IMD board is correctly indicated (see below for possible display messages and actions).

If the Installation screen has locked up altogether and does not respond to key presses check the Ram address switches are set up correctly on each card (see section 2.2.2.8). If the switches are set correctly change to the next available address as indicated in 2.2.2.8.1 and restart the installation.

- (4) Follow the instructions displayed for moving around the screen.
- (5) Select the type of Ethernet card that was installed in the PC from the options on the 'Ethernet card' menu. (If an on-bard Ethernet connection is being used, select the 'Panel PC (UM9008)' option.) On Version 7.4 software, move across to the 'Number of boards' menu and enter the number of Ethernet cards that are installed in the PC - normally 1.
- (6) On version 8.3 Software, move to the 'Tune' menu and select YES or NO, depending upon whether or not you wish the tune to be played when the TC12 PC boots up. Move across to the 'SIP' menu and select YES if a SIP is installed in the TC12 cabinet, otherwise select NO.
- (7) On Version 8.3 Software, move to the 'Comms' menu and select one of the following options:

Modem	If a conventional leased line is being used to connect the Instation to the OTUs.
Direct/Flow Control	If direct Instation to outstation, RS232, communications are being used with CTS/RTS flow control.
Direct/No Flow Cntrl	If direct Instation to outstation, RS232, communications are being used without CTS/RTS flow control.

- (8) Check the status of the DIGI I/O cards shown in the Digital I/O box. Correctly installed cards will show as 'OK', cards which are not installed will show as 'Not installed' and cards which are incorrectly installed will show an error message which may give a clue as to the nature of the problem.
- (9) Check the status of the IMD cards shown in the IMD Cards box. Correctly installed cards will be shown as 'OK' together with 2 numbers separated by a '/'. The first number is the address of the board and the second number the IRQ number of the board. Also shown will be the type of IMD board which has been detected, either 'Xi or Xe' or 'Xem'. Any boards which have not been detected by the software will be shown as 'Not detected'.

- (10) If the indications for the DIGI I/O and IMD cards are as expected, move across to the 'Install' menu, select the 'Yes' option and hit return. The TC12 Software will now be installed on the Hard disk of the PC. Should the DIGI I/O cards and/or IMD cards not be shown as expected then choose the 'Quit' option and correct the problem.
- (11) Exit the Installation software. Eject the TC12 Software disk and keep this as a backup.
- (12) Disconnect the PC from the mains and disconnect the monitor. The PC can now be installed in the TC12 cabinet.

2.2.2.11.1 Error Messages during TC12 Instation PC Software Installation

Messages and Errors that may be displayed on the 'Digital I/O boards' and 'IMD boards' status menus during the software installation and suggested corrective actions are shown below:

Displayed Message	Action to be taken
OK	None - Card installed OK
Not Installed	None unless card should be present; check card is inserted correctly in PC slot, check switch settings of Port address for IMD cards or address for Digi I/O cards (see section 2.2.2.7 or 2.2.2.8).
Ram Error	IMD cards only - check Ram address switches set up correctly on card (see section 2.2.2.8). Switches set correctly - change to next available address as indicated in 2.2.2.8 and restart installation. Switches set incorrectly - correct and restart installation.
Faulty	Replace card.
Int. Failed	Check Interrupts set up correctly on the card (see 2.2.2.8).

2.2.2.12 PC Mounting Chassis

The PC is accessible from the back of the Instation. It is placed on the PC mounting chassis (667/2/22621/000), which is a shelf at the top of the Instation. The PC is not visible from the front of the Instation as the System Fault Indication Panel is fitted across the front. The PC mains lead plugs into a socket on the Master switch Panel assembly at the back of the Instation.

Note: Lengths of 'U' channel (e.g. 915/4/03641/000) should be cut and placed along the edges of the cut-outs in the back of the PC through which cables pass, in order to eliminate the possibility of the cables chafing against the edges.

If there is more than one IMD card in the PC, care should be taken to avoid the possibility of the IMD cables chafing on the solder side of adjacent PCBs. As far as is possible the IMD PCBs should be located such that a spare slot exists between the IMD cables and adjacent PCBs.

2.2.3 Systems Fault Indication Panel (SIP)

The SIP (part number 667/1/22667/000) is 6U high and is screwed to the Instation racking in front of the PC.

If the Audible alarm on the system fault indication panel (SIP) sounds it should be cancelled as required from the UTC TCC terminal. If the reason for the alarm is a UTC TCC failure, an authorised/trained person (trained in the safety aspects of working with mains powered equipment), should be asked to cancel the audio alarm, using the audio off switch on the PSU PCB.

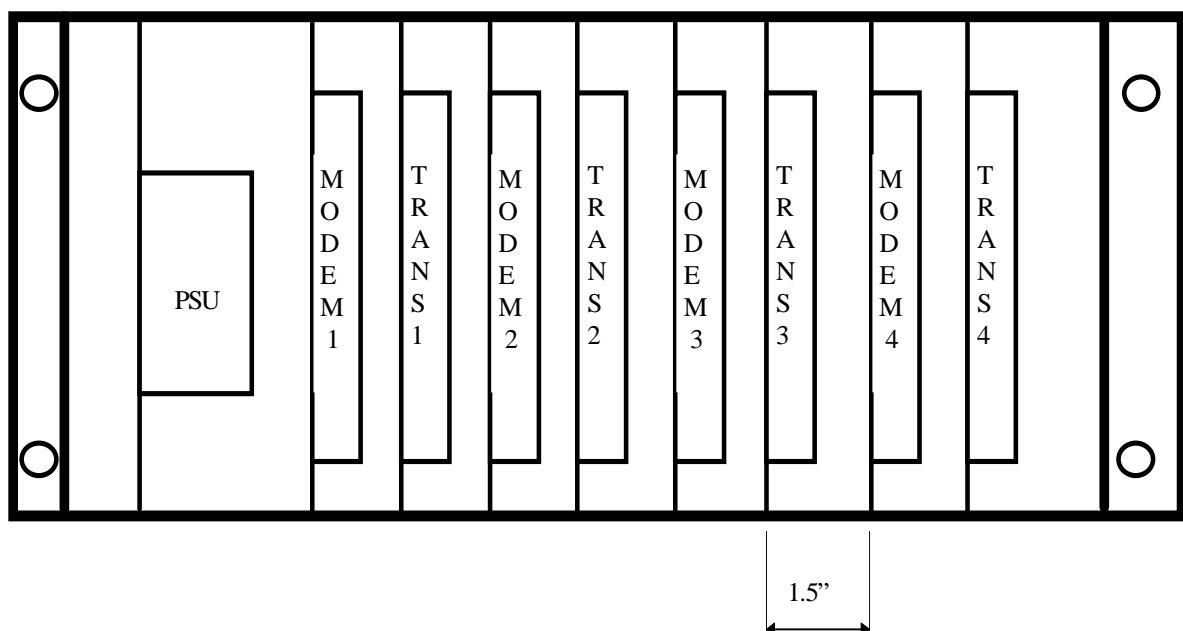
Under System Failure conditions the output relays for a remote SIP switch on and off, which gives rise to a clicking sound. If the customer wishes to stop this sound and there is no remote SIP fitted the following Resistor links may be removed from the PSU board: R25, R41, R44, and R47. See 666/CF/02249/102 at the back of the Handbook.

2.2.4 19" Racking PCBs

Figure 6 shows a front view of a fully equipped rack (there is an assembly drawing for the rack, part number 667/GA/22626/000). The cards should only be put in the slots in the order shown. A maximum of four racks may be fitted to an Instation.

Figure 6 - ITU 19" Rack (Front View)

6U Rack, Radial System



2.2.4.1 PSU PCB (inc. Digi I/O, SIP (local and remote), Watchdog and TC8 cables)

See Figure 7 for a diagram of the board layout showing the position of connectors, LEDs, switches, volume control.

SAFETY NOTE

When installing the PSU PCB in the TC12 Instation cabinet the earth strap should be bolted on to the PCB before the mains cable is plugged into the PCB. Similarly when the PSU PCB is being removed, disconnect the mains plug from the mains socket on the PCB, before removing the earth strap. Four earth straps are situated on the right-hand 19" upright of the Instation cabinet, i.e. there is one strap available at the correct height for up to four racks of TC12 that may be installed. The earth strap comes with a bolt (+ star washer) and tag on one end which is attached to the hole situated below the power supply on the PCB (see Figure 7 for position of ground hole).

The switches on the PSU PCB should be set as follows:

(See Figure 8 for diagrams of switch settings)

S1 - PC Address

This should be set to '1'. If a second rack is fitted in the Instation then the position of the switch, on the PSU Board in the second rack, does not matter. If there is more than one PC connected to the same Ethernet link, the switch should be set to 2 for the PSU Board connected to the second PC, 3 for the PSU Board associated with the third PC, etc. The switch setting should correspond to the last digit of the TC12 PC SCN in the associated UTC System's database.

S2 - Audio Alarm Configuration Switch

This is a 4-way DIL switch. The usual setting for this switch is as follows:

switch position 1 should be closed
switches 2, 3 and 4 should be open.

The function of this switch is to enable certain inputs to the board, to cause the low frequency alarm tone to sound.

Switch position	Input signal
1	Audio 1 Signal
2	Audio 2 Signal
3	Failure of PC
4	Failure of UTC TCC

Closing the appropriate switch causes the input signal indicated to cause a low frequency alarm tone, should the signal become active. Note if more than one switch is closed, any of the associated input signals becoming active, will cause the alarm to sound.

The high frequency alarm tone is sounded if the Audio 2 Signal becomes active. This is not configurable. It can only be disabled using the audio on/off switch (see below).

S3 - Audio ON/OFF

This switch should normally be set to on. If it is set off then LED LP2 will light once the board is powered up and the local SIP audio alarm will not sound in the event of any faults.

If the Audible alarm on the system fault indication panel (SIP) sounds it should be cancelled as required from the UTC TCC terminal. If the reason for the alarm is a UTC TCC failure, an authorised/trained person (trained in the safety aspects of working with mains powered equipment), should be asked to cancel the audio alarm, using the audio off switch on the PSU PCB.

Volume Control

The volume of the audio alarm is adjusted by turning the screw on potentiometer RV1.

Connector PL1

Connect the cable (part number 667/1/22612/000) from the local SIP into connector PL1 on the PSU PCB in the first rack. The PCB will need to be in the card guide for the cable to reach. If there are additional 19" racks in the Instation there is no connection to connector PL1 on the other PSU boards in these racks.

Connector PL2

Connector PL2 - No connection normally. This is used to connect to digital output boards when used in a digital output rack (See section 2.2.5.2), as well as for interfacing with the Telecommand 8 highway.

Connectors PL3 and PL4

Connectors PL3 and PL4 connect to the Digi I/O card as described in section 2.2.2.7.

Connectors PL5 to PL8

Connectors PL5 to PL8 connect to Modem PCBs as described in section 2.2.4.2.

Connector PL9

Connector PL9 - No connection normally (used for a remote SIP only).

Connector PL10 - Additional Racks In the Same Cabinet

If a further rack are included in the Instation then the PSU board on the second rack is set up as follows

Connect from PL10 on the first PSU PCB to PL10 on the second PSU PCB, using cable 667/1/22655/000. If a third rack is fitted, connect from PL10 on the second PSU PCB to PL10 on the third PSU PCB and so on.

Connectors PL1, 2, 3, 4 and 9 are not used on the PSU PCBs of additional racks. Connectors PL5 to PL8, on the PSU PCBs of additional racks, connect to modem boards in those racks.

Figure 7 - PSU Board Layout

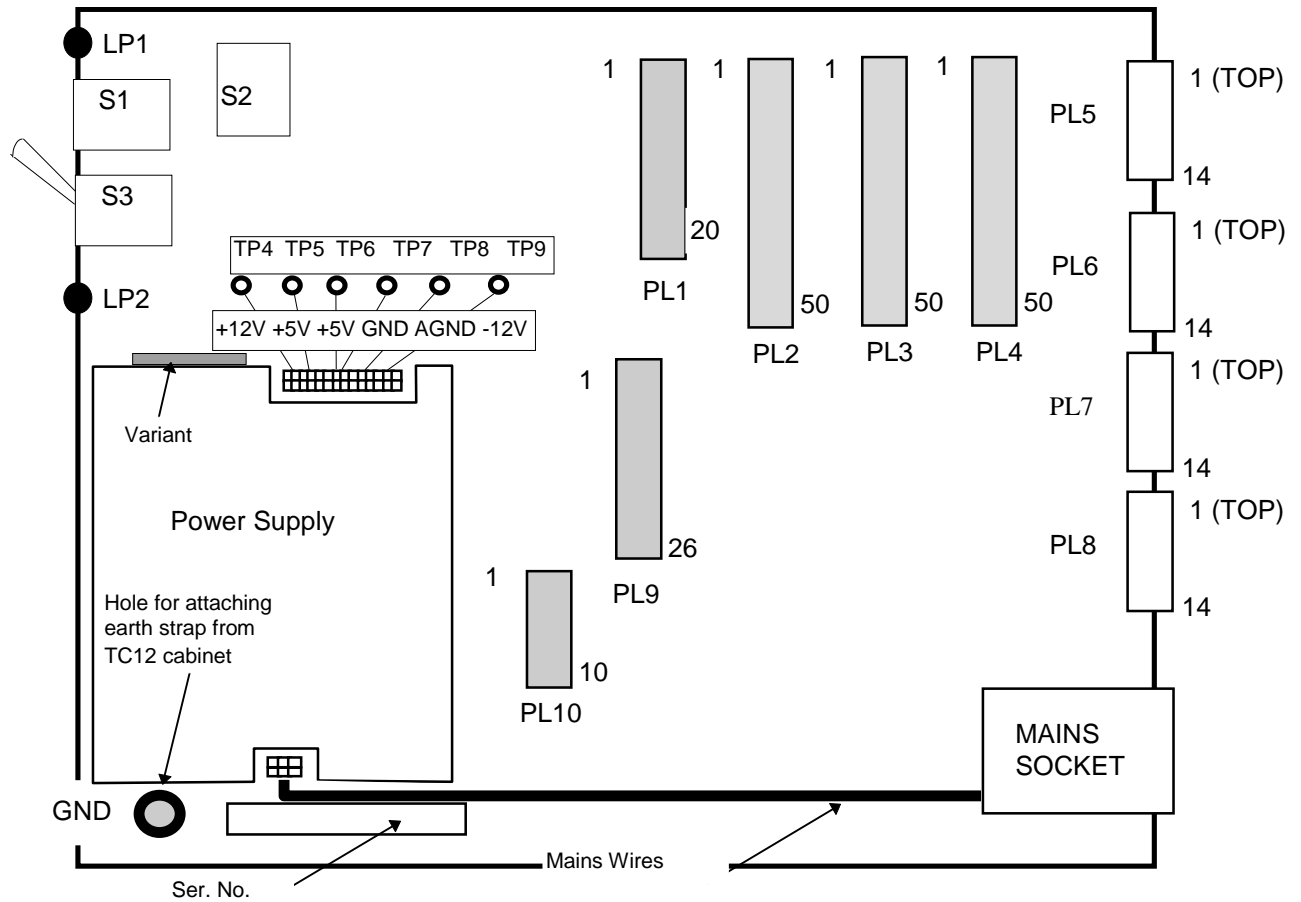
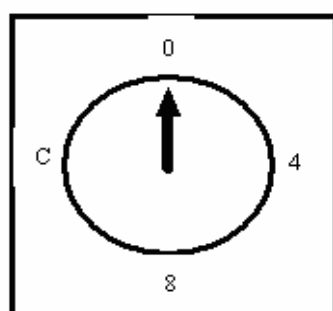


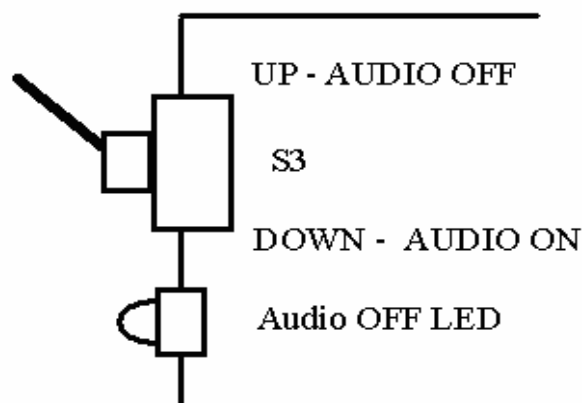
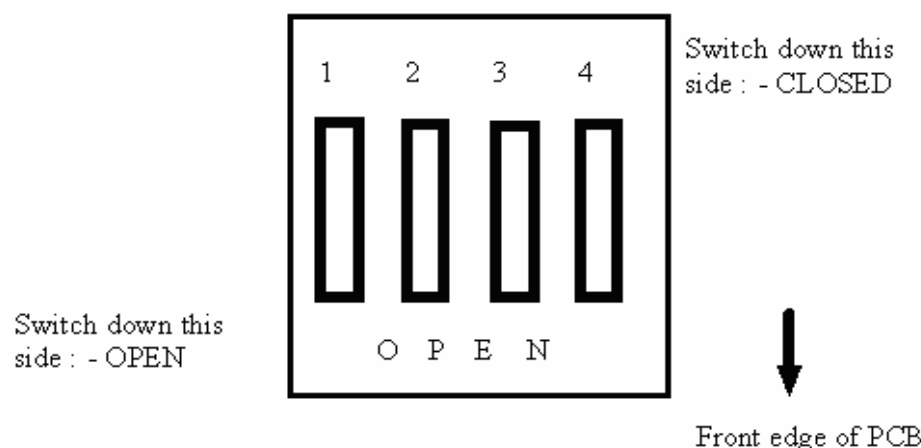
Figure 8 - PSU Board Switch Settings

S1 PC Address (Hex)



Use a small screwdriver to turn the arrow shaped slot to select the required address.

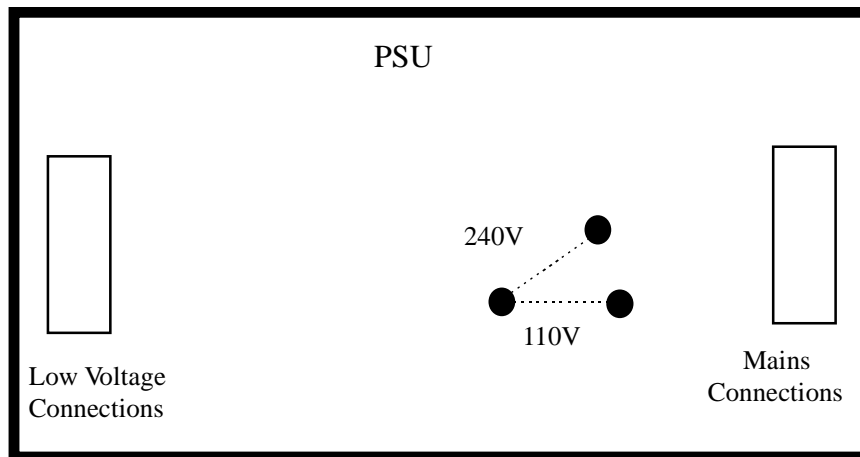
S2 Audio Alarm Configuration



Setting the Voltage Range of the PSU

The Power supply fitted to every PSU board used in the system (part number 667/7/22631/000, manufactured by Daren Electronics PLC type PP40-30). An internal link in this power supply needs to be set for the nominal mains voltage. See Figure 9 for link setting; set to 110 V position for 98 V to 132 V mains voltage range, set to 240 V for 198 V to 264 V mains voltage range.

Figure 9 - PSU Board Mains Voltage Range Setting



1. Make sure that the PSU PCB is not plugged into the Mains Supply.
2. Disconnect the low voltage and Mains connectors from the PSU.
3. Remove the four screws that attach the PSU to the PCB.
4. Remove the cover from the PSU by removing a further four screws.
5. Set the Mains voltage link inside the PSU to the required position:
110 V or 240 V, as shown in Figure 9.
6. Replace the cover and screw the PSU back on to the PCB.

Ensure that the PCB is fitted the correct way around i.e. the Mains connector and low voltage connector are at the correct ends of the PCB.

7. Re-connect the two PSU connectors

2.2.4.2 Modem PCB and Modem power cable

Figure 9 shows the position of the switches and connectors on the Modem PCB.

Ensure that the correct variant has been supplied e.g.
666/1/02243/000 for the UK.

666/1/02243/000 or 666/1/02243/001 for non-UK (the /001 variant includes extra components; metal oxide varistors and gas discharge tubes, for surge protection).

The switches on the Modem PCB should be set as follows:

Note: The tables referred to below contain 0's to indicate open switches and 1's to indicate closed switches. For all the switches push the switch down to the left for a 0 and down to the right for a 1. The 0 and 1 position is shown on the silkscreen underneath switch SW7.

1. SW1 - Mode Select switch

Ensure that the Mode Select switch is set correctly; see Table 1 for settings. One of the modes shown is selected on a 7-way DIL switch. Note NO other settings are to be used in the UK.

2. SW2, SW3, SW6 and SW7 - Line Level switches

Ensure that the Line Level switches are set correctly see Table 2 for settings). Table 2 shows switch settings corresponding to the different levels. Each modem PCB contains four DIL switches. SW2 and SW3 are 8-way DIL switches, used for setting the line levels for modem 1 and 2 respectively. SW6 and SW7 are 6-way DIL switches used for setting the line levels for modem 3 and 4. Positions 1 to 4 of all four switches set the Output Power and positions 5 and 6 set the Receive Threshold. Position 7 and 8 on SW2 and SW3 are unused. Table 2 shows the setting for the 8-way DIL switches, ignore columns 7 and 8 for the 6-way switches.

For UK use the output power is always set to -13dBm and the receive threshold is set to -39dBm.

Note: NO other setting except for -13dBm is to be used in the UK.

3. SW4 - 2/4 Wire Selector switch (SW4).

Ensure that the 2/4 Wire Selector switch is set correctly (see Table 3 for settings).

4. SW5 - Transformer Select switch.

Ensure that the Transformer Select switch (SW5) is set correctly (see Table 4 for settings). In a radial system (i.e. for any modem connecting to a transformer board, the switch is set to off board transformers. For all modems not connected to transformer boards, on board transformers are selected.

The PCB is fitted with a cover (part number 667/2/22642/000 top, /001 rear). This cover must **ALWAYS** be fitted before any connectors are attached to the PCB and should **NEVER** be removed whilst any cables are connected to the PCB.

Each Modem PCB has a 14-way ribbon cable (part number 667/1/22643/000) and a 24-way cable (part number 667/1/22640/000):

Connector PL2

The 14-way cable connects the middle header (PL2) on the Modem PCB to the appropriate 14-way header on the PSU PCB, as follows:

Modem PCB 1 -> PL8 on the PSU PCB
Modem PCB 2 -> PL7 on the PSU PCB
Modem PCB 3 -> PL6 on the PSU PCB
Modem PCB 4 -> PL5 on the PSU PCB

Connector PL1

The 24-way cable connects the top header (PL1) on the Modem PCB to four 25-way 'D' connectors on the IMD distribution panel, as follows:

Modem PCB 1 -> 'D' connectors 1-4 on the distribution panel

Modem PCB 2 -> 'D' connectors 5-8 on the distribution panel

Modem PCB 3 -> 'D' connectors 9-12 on the distribution panel

Modem PCB 4 -> 'D' connectors 13-16 on the distribution panel

Note: Once installed the 24-way cables should be tagged with a number 1-4 corresponding to the modem PCB number for future identification.

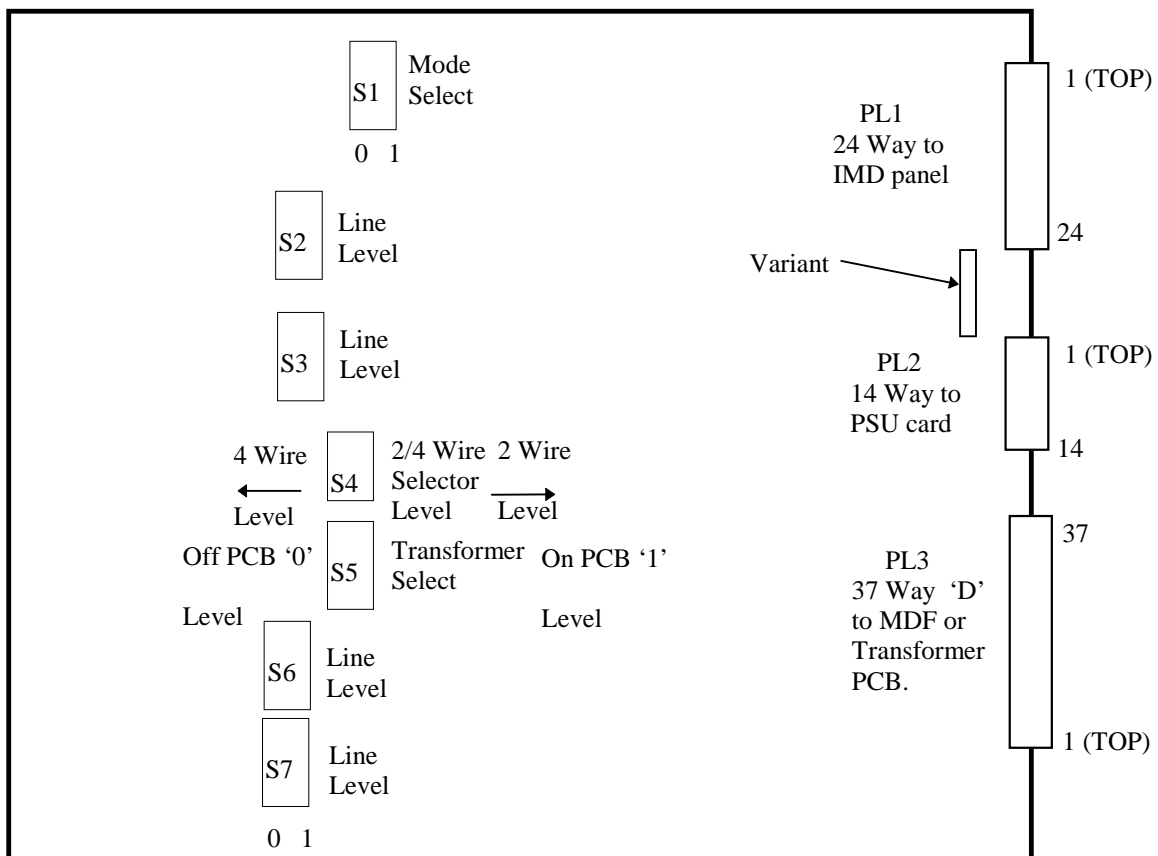
The IMD distribution modules are positioned on the hinged panel with D-type connectors 1, 5, 9 and 13 along the top row and D-types 4, 8, 12 and 16 along the bottom row (the numbers are printed alongside the D-types on the IMD distribution module). The ribbon cables from the IMD distribution modules therefore point back towards the hinged side of the plate. The 24-way cable with four D-types (from a modem PCB connections detailed above) can be cable tied along the bottom of the hinged panel, with the D-type with the shortest wires (i.e. the D-type closest to the berg connector at the other end) connected to the bottom D-type on the IMD distribution panel, and the D-type with the longest wires connected to the D-type at the top of the IMD distribution panel.

Connector PL3

Connector PL3 is used to connect to transformer boards in a system where transformer boards are used (see section 2.2.4.3).

Connector PL3 connects via a special cable to directly to the MDF in a system where transformer boards are not used (see Figure 14).

Figure 10 - Modem PCB Layout



For switches SW1, SW2, SW3, SW3, SW5, SW6 and SW7 the switch is:

OPEN i.e. '0' WHEN PUSHED DOWN TO THE LEFT, and

CLOSED i.e. '1' WHEN PUSHED DOWN TO THE RIGHT

As a reminder the '0' and '1' positions are shown on the silkscreen below SW1 and SW7.

For SW4, 4-wire is selected with the switch to the left and 2-wire is selected with the switch to the right as shown above.

Table 1 - Modem PCB Mode Select Switch (SW1)

MODE (Eng use only)	SWITCH NUMBER						
	1	2	3	4	5	6	7
		!MC0	!MC1	!MC2	!MC3	!MC4	
CCITT V.23 M2 1200 BPS HALF DUPLEX	0	1	0	0	1	1	0
CCITT V.23 M2 1200 BPS HALF DUPLEX WITH EQUALIZER	0	0	0	0	1	1	0
CCITT V.23 M1 600 BPS HALF DUPLEX	0	1	1	1	0	1	0
CCITT V.23 M2 1200 BPS FULL DUPLEX	0	1	0	0	1	0	0
CCITT V.23 M2 1200 BPS FULL DUPLEX WITH EQUALIZER	0	0	0	0	1	0	0
CCITT V.23 M1 600 BPS FULL DUPLEX	0	1	1	1	0	0	0
CCITT V.21 ORIG 300 BPS HALF/FULL DUPLEX	0	1	1	0	1	1	0

0 = SWITCH OPEN

1 = SWITCH CLOSED

See Figure 8 for Switch Positions for Switches 0 and 1

Table 2 - Modem PCB Line Level Switches (SW2, 3, 6 and 7)

	SWITCH NUMBER							
OUTPUT POWER	1	2	3	4	5	6	7	8
0dBm	1	0	0	0	-	-	1	1
-3dBm	1	0	0	1	-	-	1	1
-6dBm	0	1	0	0	-	-	1	1
-9dBm	0	1	0	1	-	-	1	1
-10dBm	0	0	1	0	-	-	1	1
-13dBm	0	0	0	0	-	-	1	1
-16dBm	0	0	0	1	-	-	1	1
RECEIVE THRESHOLD								
-42dBm	-	-	-	-	0	0	1	1
-39dBm	-	-	-	-	0	1	1	1
-33dBm	-	-	-	-	1	0	1	1

↑ ↑

Switch positions 7 and 8
apply to SW2 and SW3 only.
SW6 and SW7 are 6-way switches.

SETTING FOR UK

0 = SWITCH OPEN

1 = SWITCH CLOSED

See Figure 8 for Switch Positions for Switches 0 and 1

Table 3 - Modem PCB 2/4 Wire Select Switch (SW4)

	2 - Wire Operation	4 - Wire Operation
MODEM 1	Switch 1 → 2 - Wire	Switch 1 → 4 - Wire
MODEM 2	Switch 2 → 2 - Wire	Switch 2 → 4 - Wire
MODEM 3	Switch 3 → 2 - Wire	Switch 3 → 4 - Wire
MODEM 4	Switch 4 → 2 - Wire	Switch 4 → 4 - Wire

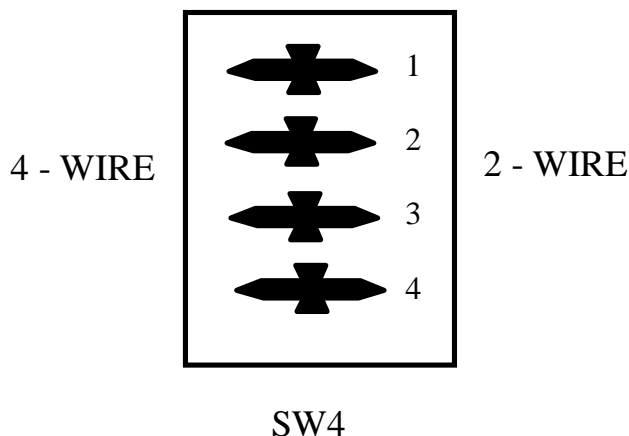


Table 4 - Modem PCB Transformer Select Switch (SW5)

Switch numbers (Corresponds to Modem with same number)					
1	2	3	4	5	6
<p>Set switch to 1 (Closed) to select on board transformer for the Modem in question i.e. for any Modem NOT connected to a transformer board.</p> <p>Set switch to 0 (Open) to select off board transformers for the Modem in question i.e. for any Modem connected to a transformer board.</p>				NOT USED	

See Figure 8 for Switch Positions for Switches 0 and 1

2.2.4.3 Transformer PCB and Modem/Transformer Cable

Figure 10 shows the layout of the Transformer PCB.

Ensure that the correct variant has been supplied e.g.

666/1/02245/000 for the UK.

666/1/02245/000 or 666/1/02245/002 for non-UK.

The PCB is fitted with a cover (part number 667/2/22647/000 top, /001 rear). This cover must ALWAYS be fitted before any connectors are attached to the PCB, and should NEVER be removed whilst any cables are connected to the PCB.

Each Transformer PCB has a ribbon cable (part number 667/1/22646/000) with a 14-way connector at one end and a 37-way 'D' connector at the other. This connects the Transformer PCB (T1, T2 etc.) to its associated Modem PCB (i.e. M1, M2 etc.).

Transformer Board Connector PL2

The cable connects from PL2 on a transformer PCB to PL3 on its associated modem PCB.

Figure 11 shows a rear view of a fully equipped rack. The positions of the ribbon cables are indicated.

Transformer Board Connectors PL1 and PL3

These connectors are used for connection to the MDF (see Figure 15).

Transformer Board Switches S1, S2, S3 and S4

Ensure that for any unused telephone lines the corresponding switches on the front of the PCB are set to ON. For example, if the 7th and 8th radial lines of modem 2 are not used then switches 7 and 8 of S2 should be put to the on position.

Figure 11 - Transformer PCB Layout

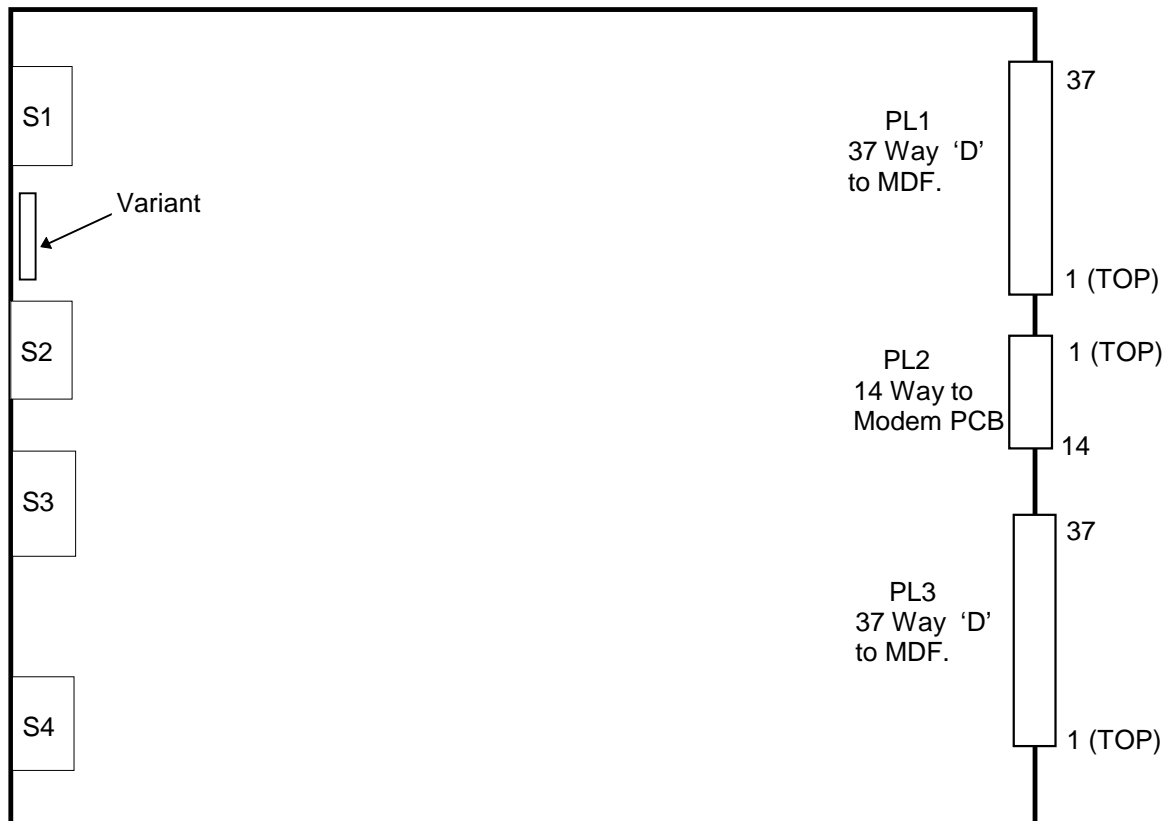
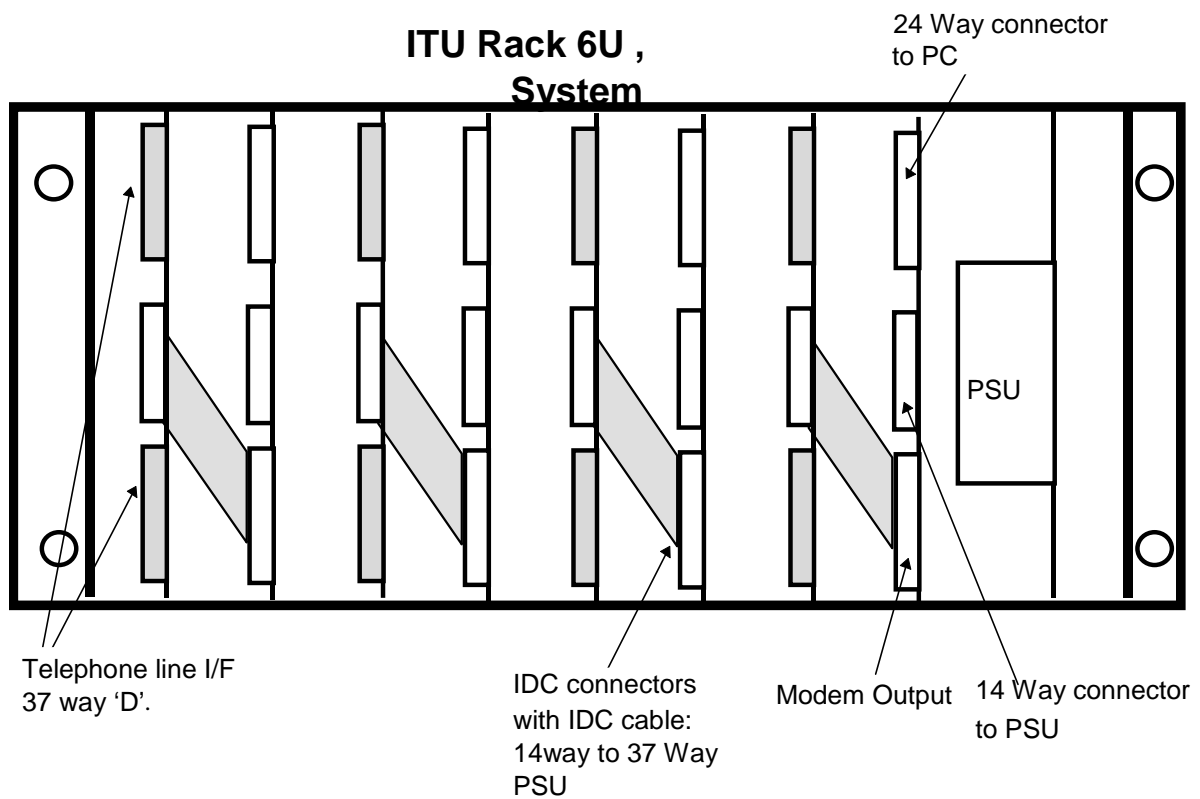


Figure 12 - ITU 19" Rack (Rear View)



2.2.5 Digital Output Rack, PCBs and PSUs

The digital output rack is the same size as the ITU rack except that 17 card guides are fitted. These take one PSU PCB and between 1 and 16 Digital Output PCBs. The assembly drawing for the rack is 667/GA/22626/001. One or two racks may be fitted to an Installation.

2.2.5.1 PSU PCB

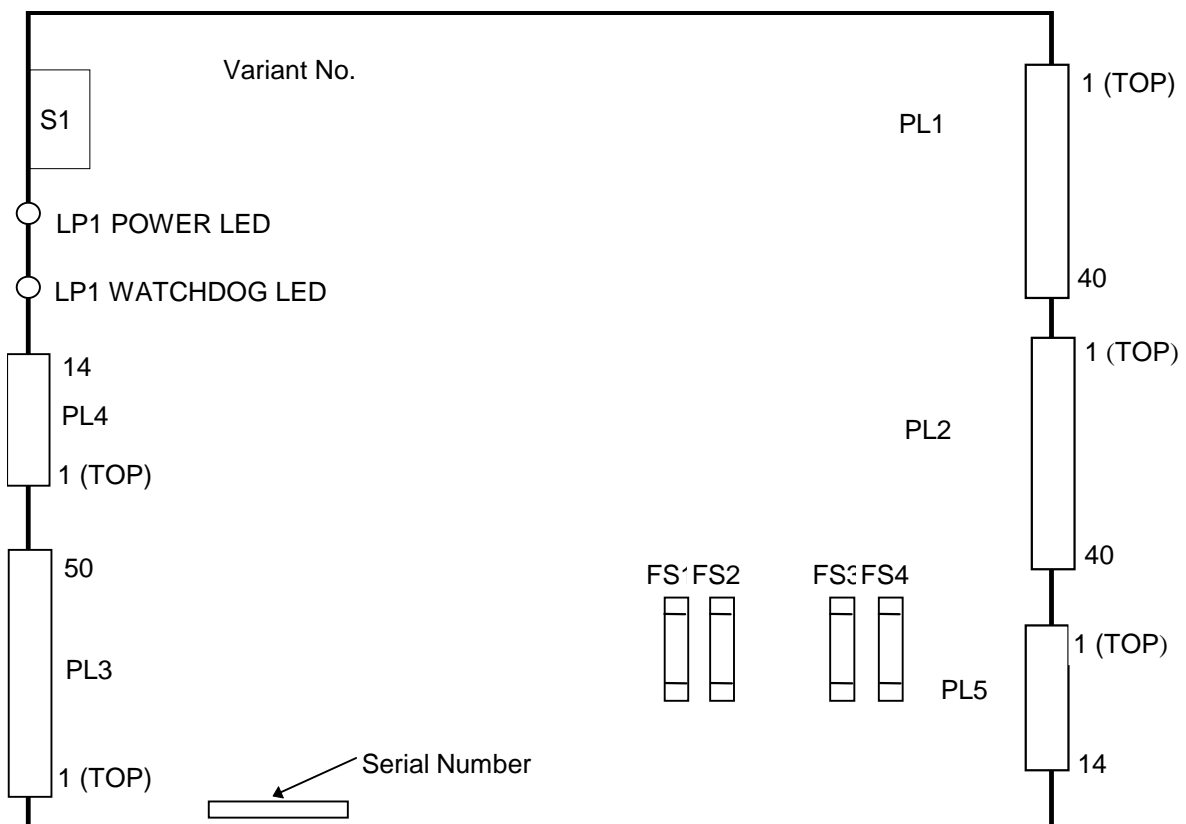
The PSU PCB is identical to the ITU rack PSU PCB so see section 2.2.4.1 for configuration details. Details of how to connect to the digital output rack are in the next section.

2.2.5.2 Digital Output PCB

There are several variants of the PCB, /000 to /099 have current source outputs and /100 to /199 have current sink outputs. The variants in those two groups are to cope with different output current limit values.

See Figure 13 for a diagram of the board layout showing the position of connectors, LEDs and switches.

Figure 13 - Digital Output PCB Layout



Switch S1 PCB Address

Set the switch on the card closest to the PSU PCB to 0, the next card to 1 and so on up to F if 16 boards are fitted.

Connectors PL1 and PL2

These connectors are used to take the digital outputs out of the cabinet. Either a ribbon cable kit (667/1/22742/000) or a discrete wire cable kit (667/1/22742/001) are used to make up the cables on installation. The pin outs are as follows:

<u>Pin</u>	<u>PL1</u>	<u>PL2</u>
1	Output 0	Output 32
2	Output 1	Output 33
3	Output 2	Output 34
4	Output 3	Output 35
5	Output 4	Output 36
6	Output 5	Output 37
7	Output 6	Output 38
8	Output 7	Output 39
9	Output 8	Output 40
10	Output 9	Output 41
11	Output 10	Output 42
12	Output 11	Output 43
13	Output 12	Output 44
14	Output 13	Output 45
15	Output 14	Output 46
16	Output 15	Output 47
17	Output 16	Output 48
18	Output 17	Output 49
19	Output 18	Output 50
20	Output 19	Output 51
21	Output 20	Output 52
22	Output 21	Output 53
23	Output 22	Output 54
24	Output 23	Output 55
25	Output 24	Output 56
26	Output 25	Output 57
27	Output 26	Output 58
28	Output 27	Output 59
29	Output 28	Output 60
30	Output 29	Output 61
31	Output 30	Output 62
32	Output 31	Output 63
33	XVCC	XVCC
34	XVCC	XVCC
35	XVCC	XVCC
36	XVCC	XVCC
37	XGND	XGND
38	XGND	XGND
39	XGND	XGND
40	XGND	XGND

Connect pins 1 to 32 to the LEDs on the wall map, and the common pin for those 32 LEDs to XVCC current sink or XGND for current source.

Connector PL3

Connect cable 667/1/22743/000, a 50 way cable with 17 sockets, to PL2 of the PSU PCB and to PL3 of all the Digital Output PCBs in the rack.

Connector PL4

Connect cable 667/1/22744/000, a 14 way cable with 17 sockets, to PL5 of the PSU PCB and to PL4 of all the Digital Output PCBs in the rack.

Connector PL5

Connect cable 667/1/22717/000 to PL5. The other end wires into a terminal block on the wall map PSU mounting panel, the other side of which connects to the DC outputs of the power supply.

2.2.5.3 Wall Map PSU

Two Wall Map PSU mounting panels (667/1/22740/000 and /001) can be fitted to the sides of the cabinet, giving a maximum of eight power supplies. Each can supply 6 A at 24 V. There is a terminal block on each panel to connect the mains to all the PSUs. Each Wall Map PSU (667/1/22741/000) contains another terminal block and wires to enable wiring of low voltage power (for driving outputs) to PL5 of a number of Digital Output PCBs. The actual number of digital output PCBs will depend on the amount of current each PCB is supplying to its outputs. See 667/CA/22741/000 and Figure 2 for wiring details.

2.2.6 PSTN Modem

If a PSTN modem (667/1/22662/000) is required this may be fitted to the back of the hinged IMD distribution panel at the back of the Instation.

2.2.7 External Cables

2.2.7.1 Mains Cable

The mains cable to the Instation should be at least 15 Amp cable, and the plug should be fitted with a fuse appropriate to the cable rating. The mains cable is wired to the input of the master switch panel RCD; refer to drawing 667/GA/22603/000 for connection details.

2.2.7.2 Ethernet cable

The TC12 Ethernet Cabling must only be used to connect a UTC Traffic Control Computer (TCC) to its associated TC12 PCs. No other equipment should be connected to this, dedicated, TC12 Ethernet cabling.

There are three different situations for connection of the Ethernet.

(1) System with a single PC using Thinwire Cable

Fit an Ethernet cable T piece (part number 667/7/22609/007) to the UTC TCC and Ethernet card on the PC.

Fit an Ethernet cable terminator (part number 667/7/22609/008) to the T piece on the UTC TCC and PC.

Fit the UTC TCC to PC Ethernet cable (part number 667/7/22609/006) between the remaining connectors on the Ethernet cable T pieces at the UTC TCC and PC.

(2) System with multiple PCs using Thinwire Cable

Fit an Ethernet cable T piece (part number 667/7/22609/007) to the UTC TCC and the Ethernet card on each PC.

Fit an Ethernet cable terminator (part number 667/7/22609/008) to the T piece on the UTC TCC.

Fit the UTC TCC to PC Ethernet cable (part number 667/7/22609/006) between the Ethernet cable T pieces at the UTC TCC and the first PC.

Fit PC to PC Ethernet cables (part number 667/7/22609/005) between the Ethernet cable T pieces at the first and the second PC.

Fit PC to PC Ethernet cables (part number 667/7/22609/005) between the Ethernet cable T pieces to link up any other PCs in the system.

Fit an Ethernet cable terminator (part number 667/7/22609/008) to the T piece on the final PC.

(3) System with single or multiple PCs using Twisted Pair Cabling

For a System which uses Twisted Pair (also known as CAT5) cabling an Ethernet hub is normally used between the UTC Traffic Control Computer (TCC) and the TC12 PC(s). CAT5 (Twisted Pair) cable is used to connect the TCC to the hub and to connect the hub to the TC12 PC(s).

2.2.7.3 Modem PCB to BT cable

This cable is only fitted if there is no associated Transformer PCB with the Modem PCB. Figure 14 shows the cable terminations for connection to the MDF.

The cable is a 10 pair cable (part number 667/1/22654/000) with 8 pairs actually used. Refer to drawing 667/GA/22654/000 for wire colours etc. The cable connects to PL3 on the modem PCB.

BT cable tool, part number 667/7/22648/000 is used when installing the cable.

Cable termination depends on whether the modem is connected in 2 or 4 wire mode:

2 Wire Connection (Control and reply use same wire pair)

Modem 1	Control/Reply	TD1+ TD1-
Modem 2	Control/Reply	TD2+ TD2-
Modem 3	Control/Reply	TD3+ TD3-
Modem 4	Control/Reply	TD4+ TD4-

4 Wire Connection (Control and reply use separate wire pairs)

Modem 1	Control	TD1+ TD1-
	Reply	RD1+ RD1-
Modem 2	Control	TD2+ TD2-
	Reply	RD2+ RD2-
Modem 3	Control	TD3+ TD3-
	Reply	RD3+ RD3-
Modem 4	Control	TD4+ TD4-
	Control	RD4+ RD4-

Figure 14 - Modem PCB - MDF Connections

MODEM PCB - PL3		
37 Way 'D' Connector to transformer PCB or MDF		
PIN	NAME	NOTES
1.	TD1+	To MDF
2.	RD1+	To MDF
3.	TD2+	To MDF
4.	RD2+	To MDF
5.	TD3+	To MDF
6.	RD3+	To MDF
7.	TD4+	To MDF
8.	RD4+	To MDF
9.	NC	
10.	NC	
11.	NC	
12.	NC	
13.	NC	
14.	RTN4	To Transformer PCB
15.	NC	
16.	MD3	To Transformer PCB
17.	RTN2	To Transformer PCB
18.	NC	
19.	MD1	To Transformer PCB
20.	TD1-	To MDF
21.	RD1-	To MDF
22.	TD2-	To MDF
23.	RD2-	To MDF
24.	TD3-	To MDF
25.	RD3-	To MDF
26.	TD4-	To MDF
27.	RD4-	To MDF
28.	NC	
29.	NC	
30.	NC	
31.	NC	
32.	NC	
33.	MD4	To Transformer PCB
34.	RTN3	To Transformer PCB
35.	NC	
36.	MD2	To Transformer PCB
37.	RTN1	To Transformer PCB

2.2.7.4 Transformer PCB to BT cable

Figure 14 shows the cable terminations for connection to the MDF.

Two identical cables are used (part number 667/1/22654/001). These connect to PL1 and PL3 on the appropriate Transformer PCB. The cable connected to PL1 connects all the OTUs associated with modems 1 and 2. The cable connected to PL3 connects all the OTUs associated with modems 3 and 4. Each of the two cables is a 20 pair cable with up to 16 pairs actually used. Refer to drawing 667/GA/22654/001 for wire colours etc.

If only one modem (of the four available on a modem PCB) is being used then a 10 pair cable can be used, part number 667/1/22654/000. Refer to drawing 667/GA/22654/000 for wire colours associated with particular connector pins.

If the 10 pair cable is used then the following two connections are possible:

1) 10 Pair cable connected to PL1:

Modem 2 only used with pair	TP9 of 10 pair cable to OTU 2A
	TP8 of 10 pair cable to OTU 2B
	TP7 of 10 pair cable to OTU 2C
	TP6 of 10 pair cable to OTU 2D
	TP5 of 10 pair cable to OTU 2E
	TP4 of 10 pair cable to OTU 2F
	TP3 of 10 pair cable to OTU 2G
	TP2 of 10 pair cable to OTU 2H

2) 10 Pair cable connected to PL3:

Modem 4 only used with pair	TP9 of 10 pair cable to OTU 4A
	TP8 of 10 pair cable to OTU 4B
	TP7 of 10 pair cable to OTU 4C
	TP6 of 10 pair cable to OTU 4D
	TP5 of 10 pair cable to OTU 4E
	TP4 of 10 pair cable to OTU 4F
	TP3 of 10 pair cable to OTU 4G
	TP2 of 10 pair cable to OTU 4H

BT cable tool, part number 667/7/22648/000 is used when installing the cable.

Figure 15 - Transformer PCB - MDF Connections

TRANSFORMER PCB PL1 and PL3		
37 Way 'D' Connector to MDF		
PIN	PL1 NAME	PL3 NAME
1.	NC	NC
2.	OTU2H-	OTU4H-
3.	OTU2G-	OTU4G-
4.	OTU2F-	OTU4F-
5.	OTU2E-	OTU4E-
6.	OTU2D-	OTU4D-
7.	OTU2C-	OTU4C-
8.	OTU2B-	OTU4B-
9.	OTU2A-	OTU4A-
10.	OTU1H-	OTU3H-
11.	OTU1G-	OTU3G-
12.	OTU1F-	OTU3F-
13.	OTU1E-	OTU3E-
14.	OTU1D-	OTU3D-
15.	OTU1C-	OTU3C-
16.	OTU1B-	OTU3B-
17.	OTU1A-	OTU3A-
18.	NC	NC
19.	NC	NC
20.	NC	NC
21.	OTU2H+	OTU4H+
22.	OTU2G+	OTU4G+
23.	OTU2F+	OTU4F+
24.	OTU2E+	OTU4E+
25.	OTU2D+	OTU4D+
26.	OTU2C+	OTU4C+
27.	OTU2B+	OTU4B+
28.	OTU2A+	OTU4A+
29.	OTU1H+	OTU3H+
30.	OTU1G+	OTU3G+
31.	OTU1F+	OTU3F+
32.	OTU1E+	OTU3E+
33.	OTU1D+	OTU3D+
34.	OTU1C+	OTU3C+
35.	OTU1B+	OTU3B+
36.	OTU1A+	OTU3A+
37.	NC	NC

2.3 COMMISSIONING

2.3.1 Safety Tests on the TC12 Instation

2.3.1.1 Test Equipment Required

Multimeter (e.g. Fluke 77 or similar).

Comark Insulation Meter 1905 (or similar capable of 1000 V).

Clare R133R10 Earth Continuity Tester (or similar).

RCD Tester (e.g. Seaward RC500).

2.3.1.2 Safety Considerations

Statutory and Company legislation relating to safety must be followed. During testing hazardous voltages will be present, only qualified personnel are allowed to operate the equipment with hazardous voltages present.

ELECTRIC SHOCK RISK - hazardous voltages are present within the equipment - observe any warning labels and do not remove any protective covers.

2.3.1.3 Pre-test Inspection

Check that the correct fuses are fitted to the Instation (see section 2.4.9 for a description of fuses fitted to the Instation). Carry out a visual inspection to check all earth connections are made and that the associated screws are done up firmly. Check that the mains cables are plugged into each PSU PCB and PC used.

2.3.1.4 Outline of Tests to be Performed

The sequence of tests will be:

- (1) Earth Continuity Check
- (2) Insulation Check (1000 V DC Test)
- (3) RCD Test.

2.3.1.5 Earth Continuity/Insulation Resistance Test Set Up

The Instation is disconnected from the mains during these tests.

2.3.1.6 Earth Continuity Test Procedure

Connect one probe of the Earth Continuity Tester to the Earth wire of the Instation mains cable. Connect the other probe to the following points (it may be necessary to find a suitable place to test without paint) and make sure the reading is below 0.5 Ohms:

Cabinet Uprights

Cabinet Side Cover stud left hand side
Cabinet Side Cover stud right hand side
Cabinet Top Cover
Cabinet rear door
Metal Part of front door along hinged side
SIP Panel
IMD Panel
Master Switch Panel at the rear of the cabinet
Master Switch panel cover (aluminium plate behind the master switch panel).
Mains socket panel at the front of the cabinet
Any installed 19" racks - both left and right mounting flanges should be checked
PC Mounting metalwork
Case of power supply on every PSU Board Installed.
Volt rail on the PSU PCB of every TC12 rack installed in the cabinet The 0 Volt rail is accessible at terminal pin TP7 on the PSU PCB, see Figure 7 for position of this terminal pin on the PCB.
All earthed points on any other equipment which may have been included in the cabinet.

If after the on site earth continuity test, any rack or panel is removed or replaced, then the earth continuity check to that item should be repeated.

2.3.1.7 Insulation Resistance Test Procedure

SAFETY NOTE

Personnel should take care that they do not come into contact with the high voltages generated by the Test Instrument.

Set the insulation meter to 1000 V DC.

Make Sure that the Instation is not connected to the mains, but that all fuses are in place, all switches are on (i.e. master Switch and Switches for front and rear mains socket panels) and that all PCBs etc. are in place.

Connect the LIVE and NEUTRAL of the Instation mains wire together.

Connect the meter to measure between the Instation mains wire EARTH and the combined LIVE and NEUTRAL.

Allow the meter reading to settle during the test.

The insulation resistance should be not less than 10 MOhm.

Note Once the Instation has passed the Insulation resistance test it should not be repeated unnecessarily as the mains filters may be damaged.

WARNING Mains filters may remain charged for some time after the insulation tests have been completed.

2.3.1.8 RCD Tests

Turn the Instation master Switch OFF.

Connect the Instation to the mains.

Switch the Instation master Switch ON.

Plug the RCD Tester into a mains socket at the front of the Instation. Set the trip current on the tester to 30 mA. Press the button on the tester. Check on the RCD tester display that the RCD has tripped within 200 ms. Reset the RCD.

Set the trip current on the tester to 150 mA. Press the button on the tester. Check on the RCD tester display that the RCD has tripped within 40 ms.

Disconnect the tester from the controller and reset the RCD.

2.3.1.9 Safety of Mains Supply at Customer Site

The customer is to ensure that the mains supply that the Instation is to be plugged into meets the requirements of IEE Wiring Regulations (BS7671).

2.3.2 Commissioning Procedure after Power Up

Switch on and check all power LEDs on the PSU and Modem PCBs are lit.

Check that the transmit LEDs (green) and receive LEDs (yellow) on the modem PCBs illuminate correctly - see section 2.4.1.

2.4 MAINTENANCE

2.4.1 Status LEDs

LEDs are provided on the front edge of the Modem Board and PSU Board to provide basic status information. The position of these LEDs and their functions are shown in Figure 16.

Modem PCB

All power LEDs on the modem PCB should be ON.

The yellow transmit LEDs indicate that the particular modem has received a request to send. In normal working this means that the control signal is being transmitted on the line. However if switches/cables have been set up incorrectly the LED may be ON, without the control signal actually reaching the line. All yellow LEDs on all modem PCBs should go on together (though not necessarily go off at the same time) once per second.

The green receive LED (Carrier detect) should come on once for every OTU which replies on the line during the second (the LED is set by the modem carrier detect output and does not indicate that the carrier detected was a valid reply message).

PSU PCB

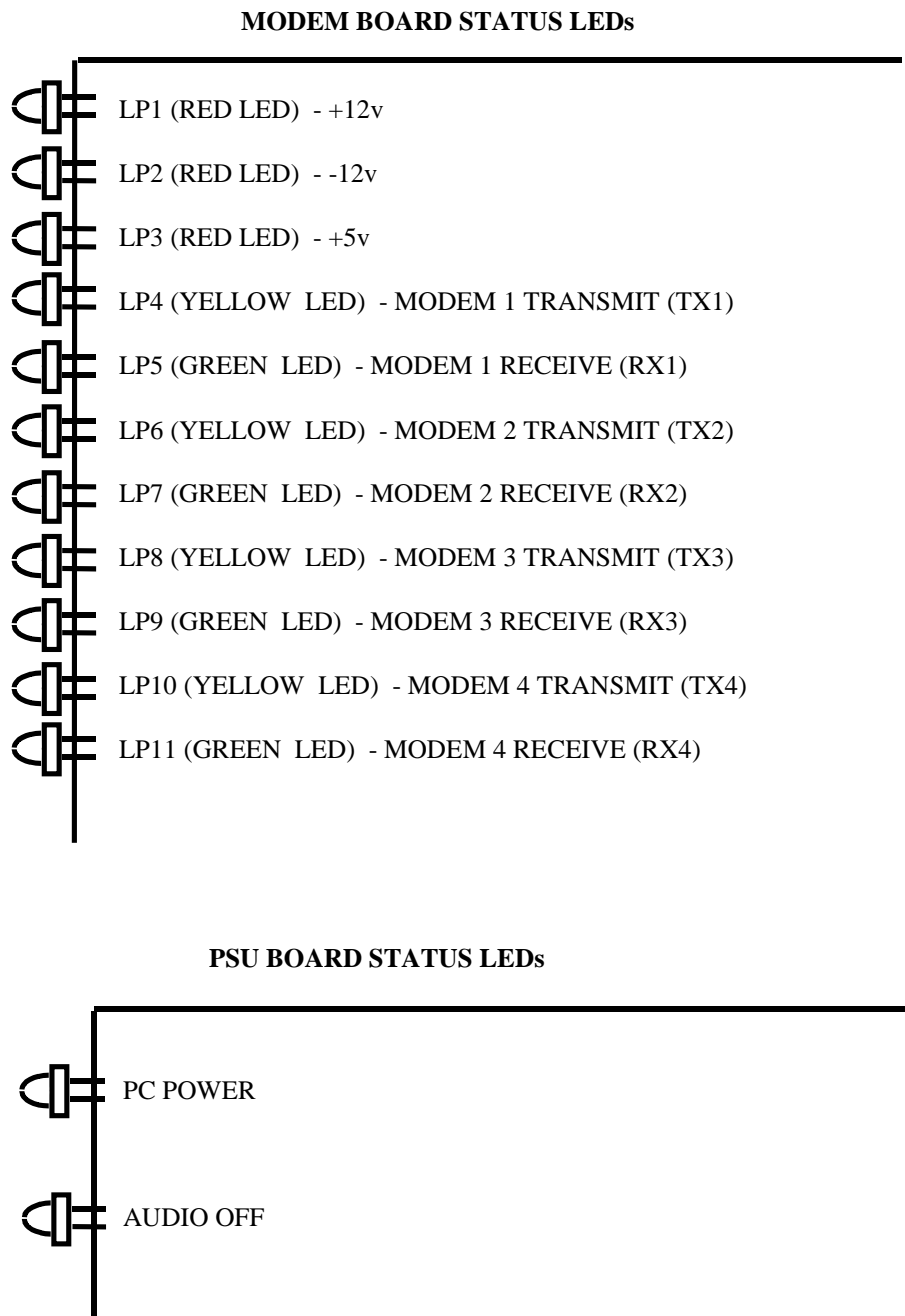
The PC power LED on the PSU PCB should be ON. IF it is OFF then there is a fault, however no audible alarms will sound and no LEDs will illuminate on SIP panel if the PC has no power.

Digital Output PCB

The Digital output PCB has two status LEDs. The top LED indicates that the Power to the board is OK (5 V supply from PSU PCB).

The second LED on the digital output PCB indicates a watchdog fail. If this occurs all digital outputs are switched off on that board.

Figure 16 - Modem and PSU PCB Status LEDs



2.4.2 Effect of Incorrect Switch Settings on the PSU PCB

(1) S1 - PC Address

If this switch is set to a PC number which does not exist, the UTC TCC FAIL indicator on the local SIP will light up. The traffic control computer will display an error message to say that the PC is disconnected.

(2) S2 - Audio Alarm Configuration Switch

This controls what signals can cause the low frequency audio alarm to sound. If it is incorrectly set, the alarm may sound for reasons other than those expected or may not sound when expected.

(3) S3 - Audio ON/OFF

If the audio alarm does not sound when expected check that this switch is set correctly. If it is set to off the audio off LED, on the front of the PCB, will be illuminated.

(4) Alarm Volume Control (RV1)

If the Audio alarm volume control is set too low it may not be possible to hear the audio alarm.

2.4.3 Effect of Incorrect Switch Settings on the Modem PCB

(1) SW1 - Mode Select Switch

If this is set incorrectly the four modems on the modem PCB may not work at all or will be set to a spurious mode. The yellow LED (request to send) may light for each modem, but the green LED (carrier detect) may not.

(2) SW2, SW3, SW6 and SW7 - Line Level Switches

SW2 and SW3 are 8-way switches used to set line levels for modem 1 and modem 2 on the Modem PCB. If switch positions 1 to 4, of the DIL switch, are set incorrectly the particular modem will transmit at the wrong output power.

WARNING - FOR UK USAGE THE OUTPUT POWER MUST NOT BE SET TO GREATER THAN -13 dBm.

If switch positions 5 and 6 are set incorrectly the receive threshold for the particular modem will be wrong. If it is set too low, corrupted reply messages may occur, in which case reply too early errors may be displayed on the TCC. If set too high the reply messages from the OTUs may be undetected - the yellow LED will light for the appropriate modem but the green LED will not.

If Switch position 7 is set open, there will be no Control Signal on the line. The yellow LED will light but the green LED will not light.

If Switch position 8 is set open, there will be no Reply Signal on the line. The yellow LED will light but the green LED will not light.

SW6 and SW7 are 6-way DIL switches used to set line levels for modem 3 and modem 4 on the Modem PCB. Incorrect setting of these switches will have the same effect on these modems, as switch positions 1 to 6 described above.

(3) SW4 - 2/4 Wire Selector Switch

a) 4 wire system but with 2 wire selected in error:

No reply messages will be received. In Full duplex mode the yellow and green LED for the modem will come on simultaneously every second. In half duplex mode only the yellow LED will come on.

b) 2 wire system but with 4 wire selected in error:

No reply message will be received. Only the yellow LED for the modem will come on.

(4) SW5 - Transformer Select Switch

a) On board transformers required but off board set in error.

No Control signal on the line and therefore no received signal. The yellow LED will be on and the green LED off.

b) Off board transformers required but on board set in error.

The power output of the control message on the line will be reduced.

2.4.4 Effect of Incorrect Switch Settings on the Transformer PCB

S1, S2, S3 and S4:

If the switch is set On when there is an OTU on the line then no Control message will be sent to the OTU.

If the switch is left switched off when there is no OTU on that line, this may affect the integrity of the control signal to other OTUs connected to the same modem.

2.4.5 Effect of Incorrect Switch Settings on the Digital Output PCBs

S1 - PCB Address

If PCB addresses are duplicated on one or more boards, the outputs on each board will be set identically.

2.4.6 Fault Finding at the Instation

2.4.6.1 UTC TCC Communication Problems

Symptom

No UTC TCC communications with Instation, SIP VAX LED on.

No UTC TCC communication with Instation, SIP VAX LED off

Possible Reason

Incorrect installation of PC Ethernet card or cables or faulty Ethernet card. On the 3Com Ethernet card, failure to disable the memory can cause this failure.

No Ethernet cable/cable not attached.

A 50 Ohm termination has been missed off one of the Ethernet T-pieces, either at the UTC TCC or at a PC. PC address on PSU board is set to invalid number i.e. 0 or F.

PC address on PSU PCB is set duplicated in another Instation; only one Instation will operate correctly.

IMD Interrupt Vector switch DS2 incorrectly set.

PC not powered up - Check PC power LED on PSU PCB.

2.4.6.2 PC Failure

Symptom	Possible Reason
PC not Powered	PC Switched off. Power cable disconnected/faulty. Mains plug fuse blown Master switch panel off/fuse blown.
SIP PC 1 LED ON	PC faulty. Digi I/O card card/cables installed incorrectly. Digi I/O card faulty. PC Not running TC12 software. Check software installation and re-boot PC. Software has failed - ignore all other SIP LEDs/audio (software driven). Re-boot PC. Re-install software and re-boot.

Note. *If it becomes necessary to replace an IMD distribution box or the associated PCB they must be replaced in pairs.*

2.4.6.3 Modem Communication Problems

Symptom	Possible Reason
No communication from one modem on modem PCB - others OK	D-type disconnected from IMD distribution module Modem/IMD cable faulty Incorrect MDF connection OTU Disconnected/faulty
No communication from all four modems on Modem PCB	Incorrect Mode set on Modem PCB. Radial system with modem PCB to transformer PCB cable, disconnected/ faulty Modem/IMD cable not connected/ connected to wrong four D-types/ cable faulty No power to modem PCB - check power LEDs, check modem PCB to PSU PCB cable Telephone line connection problem at MDF
No communication from all modems in one rack	No mains connection to PSU PCB Low Voltage side of PSU not connected on PSU PCB PSU faulty on PSU PCB No PSU PCB to modem PCB cables attached IMD card/cables installed incorrectly/ faulty

2.4.6.4 Digital Output PCB Problems

Symptom	Possible Reason
Power LED not on	PSU PCB to Digital Output PCB ribbon cable not connected or faulty. Problems with PSU PCB i.e. fuse blown/no power to PSU/faulty PSU
Watchdog Fail LED ON for all PCBs connected	Check SIP Panel PC 1 LED. If on, PC software is not running - reboot PC

Symptom	Possible Reason
Watchdog Fail LED ON for only one	PSU to Digital Output PCB watchdog ribbon cable faulty/not connected
Digital Output PCB of several	Watchdog ribbon cable faulty
Digital Outputs Not Driven	Digital Output PCB faulty
	Watchdog Failure
	Digital Output PCB fuse(s) blown
	Incorrect/faulty wiring
	Digital Output PSU not connected
	Digital Output PSU fuse blown/faulty

2.4.7 Replacing Modem, Transformer and Digital Output PCBs

The modem and transformer and Digital Output PCBs can be removed and replaced whilst the rack is powered up. Disconnect the attached cables from the PCB, push down the latch on the front of the PCB guide and slide the PCB out of the rack. Insert the new PCB and reconnect.

2.4.8 TC12 Instation PC Help / Diagnostic Screens

If a monitor is attached to the TC12 PC (note the TC12 Instation Test Set can be used as the monitor) a number of Help/Diagnostic screens are available in the TC12 PC Software. These are described below.

2.4.8.1 Help screen, Key to Press 'H'

This Screen lists all of the diagnostic and help screens and keys to be pressed to activate them.

2.4.8.2 First 22 TC12 OTUs on an Instation, Key to Press '2'

This screen displays the replies received from the first 22 TC12 OTUs on an Instation. It displays each OTU's reply on a separate line on the screen, OTU 0 at top. This screen only shows the first 22 OTUs on an Instation but can be used to obtain indication of the health of the system.

The first eight digits on a line are characters indicating what errors were detected with the particular OTU reply. The characters represent the errors as follows.

A = Address error
M = MT (message transfer) bit set in reply
N = No reply
S = Short reply
C = reply CRC error
P = parity error (not used in TC12)
F = framing error in reply
O = over run error on reply message

The remaining characters on each line are the hexadecimal representation of the reply bytes (___ means no data) for that OTU, each line is the correct length (number of characters) for the number of reply bytes for the OTU.

2.4.8.3 First 22 TC8 OTUs on an Instation, Key to Press '8'

This screen displays the replies received from the first 22 TC8 OTUs on an Instation. It displays each OTUs reply on a separate line on the screen OTU 0 at top. The format of each line is as for TC12 above.

This screen only shows the first 22 OTUs on an Instation but can be used to obtain an indication of the health of the system.

2.4.8.4 Active tasks, RX/TX packets and time events, Key to Press 'A'

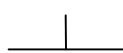
This screen, as its name suggests, shows the processes going on within the Instation against time, each dot represents 400ths of a second and the screen shows processes in any one second. For its full understanding a good working knowledge of the Instation is required, however it is possible to see if one particular task or time event is running more often than is normal or using up more time than normal.

The graphical representation noted below are described as if viewing a monochrome screen, however notes are made alongside to state what the colour would be if a colour display were employed.

Meanings of the graphics

A dot . is a single 400th of a second time period

Inverse video blocks (brown) Indicate time events during which for example data is output to TC8 OTUs. Digit above indicates time spent on event, should not normally go above 5.



Indicates a packet received from the host UTC TCC via the Ethernet, usually on bottom line of those displayed and right hand corner.

It should be within the following bounds

It can be in yellow area

It should be in the red or green area as shown below

If it goes into the blue area it will be rejected and not acted upon.

17 dots

3rd line| Start of yellow area.....

8 dots 8 dots 10 dots

4th line ...continuation of yellow area |.....|.....|..... end of 4th line
RED | GREEN BLUE.



Indicates a packet transmitted to the host UTC TCC normally on top line of display

Characters 0 to C indicates task with the following significance

C= 1 second timer update task, not normally visible.

B= High priority message received from the host UTC TCC ready for output

A= Input from IMD usually reply data and process ready to transmit as a packet back to host UTC TCC.

9= Message ready received across Ethernet from host/UTC TCC.
This is then distributed as necessary to High and Low priority message tasks and configuration message task.

8= Not Used

- 7= Low priority message ready from UTC TCC to output e.g. digital outputs
- 6= Replies to a particular host UTC TCC where the Instation is only handling digital Output for the particular host UTC TCC, with delays on answering to maintain communication timings.
- 5= Configuration processing i.e. processing of configuration packets from host UTC TCC to setup Instation.
- 4= Sumchecking IMDs done at beginning of every second (top left hand corner of display. To ensure IMDs have correct timings and data before allowing them to proceed with their transmission of data to the modem boards and ultimately the OTUs.
- 3= Discarding memory, this task is passed memory by the other task for it to discard.
- 2= processing for the Keyboard and Instation VDU i.e. standard monitor if connected not emulated monitor.
- 1= Serial processing including emulated monitor.
- 0= Lowest task Instation initialisation.

2.4.8.5 Internal Error Counts, Key to Press 'B'

This screens shows counts of memory allocation errors associated with the allocation of memory into which a packet received from the host UTC TCC is placed and memory in which a packet is built prior to transmission back to the host UTC TCC.

Rx packet allocation failures
Packet buffer allocation failure

These should never be other than zero 0.

2.4.8.6 Computer Links, Key to Press 'C'

Decnet Address = Address of the Instation PC on the Ethernet.

Timeout_count (usually 3) = Number of consecutive missing messages before PC times out and ignores Ethernet link.

Sip_output = Indicates last states of 8 outputs which are sent to the Systems Indication Panel, 1 = On.

Sip_Flash = Indicates which outputs were required to be flashing when last sent to the Systems Indication Panel, 1 = Flash.

Sip_input_last_sent = States of 8 input available from Systems Indication panel when last checked.

2.4.8.7 Digital Outputs states, Key to Press 'D'

This screen displays the output states, of the first 24 TC12 digital output boards; each line represents 64 digital outputs i.e. one board. As there is the possibility of 16 boards in a rack the first 16 lines therefore would represent first rack.

This display is in colour and CTERM should be switched into the colour mode to gain any information from this screen Press CNTRL K.

The colours used are as follows and correspond to shades as detailed below for the monochrome screen used on the test set.

Colour	Shade	Meaning
Blue	Lightest	Not used
Red	Medium	In use for driving TC8
White	Darkest	Actual states of inputs when in use.

NB If only two shades can be seen it may be possible to distinguish what is being shown in the following ways.

If 'O' is pressed the screen will be blank if there is NO TC8, if TC8 is being driven screen will show data. With this knowledge above screen can be interpreted as TC8 Outputs are always the first shown on the above screen i.e. top lines.

2.4.8.8 Event flags, Key to Press 'E'

This screen and the flags are self descriptive, however on the terminal emulator the line showing the state of the flags cannot be viewed and this screen is therefore of no use under normal circumstances.

2.4.8.9 Free time, Key to Press 'F'

This screen shows the current, worst, best and average free time as percentages. NB After re-booting the Instation PC worst percent free time goes to 0%, as during initialisation it is allowed to use all time available for processing. To determine the worst percentage free time during normal operation reset counters once operating normally by pressing 'Z'. The worst percentage free after five minutes should be an accurate figure for the system.

2.4.8.10 Help Screen, Key to Press 'H'

This screen lists all of the screens detailed in this section.

2.4.8.11 IMD Information Screen, Key to Press 'I'

This provides information about the Intelligent Modem Driver boards in the PC as follows.

Top Line: Address of the dual ported RAM through which the PC communicates with the IMDs.

Below this there are details of each of the four possible IMDs, as follows.

Status of the IMD:

Either OK / NOT INSTALLED / FAULTY / SUM CHECK ERROR.

Followed by a series of digits. These series of digits for each IMD relate to the states of certain MODEM lines as defined below.

	<u>Current</u>	<u>Cumulative</u>
Raised RTS and did not receive CTS	0000000000000000	0000000000000000
Started transmitting and lost CTS before completed	0000000000000000	0000000000000000

2.4.8.12 Link Statistics, Key to Press 'L'

This screen gives details of the Ethernet link to the host UTC TCC.

The addresses of the Instation on the Ethernet	ADDRESS and MULTICAST ADDRESS
The type of driver card being used - Thin wire, Thick wire or both as detected by the driver software	MODULE TYPE
Type of Ethernet card selected when installation programme used	ADAPTER CARD
The type of communication being used NB The count increments against the form of communication being used.	RECEIVE LOOK AHEAD or RECEIVE CHAIN
Whether or not adapter card has failed. This is '1' if failed	ADAPTER CHECK
Count indicating number of times the status / set up of the link driver has changed	STATUS INDICATION
Details on bad packets from Ethernet	
Count of packets that were too short (since starting PC)	TOO SHORT
Count of packets with wrong protocol (since starting PC)	WRONG PROTOCOL
Count of packets which had invalid destination address i.e. were not intended to be picked up by this Instation PC (since starting PC)	INVALID DESTINATION
Bad Packet Protocol	Protocol number of last bad packet
Bad Packet Source	Source address of last bad packet
Bad Packet Destination	Destination address for last bad packet

2.4.8.13 Free memory, Key to Press 'M'

This gives an indication in Kbytes of the memory free within the PC that the software could make use of.

2.4.8.14 Telecommand 8 Output, Key to Press 'O'

This screen shows any data being Output (2 words allowed for each OTU) to the first 88 Telecommand 8 OTUs if there are any connected to the instation. If there are no TC8 OTUs connected to the Instation this screen is blank.

2.4.8.15 Received Characters IMD, Key to Press 'R'

This screen displays the data received from OTUs on IMD 0 port 0. It displays each OTUs reply on a separate line on the screen OTU 0 at top. This screen only shows the OTUs on IMD 0 port 0 but can be used to obtain indication of the health of the system.

The characters on each line are the hexadecimal representation of the reply bytes (___ means no data) for that OTU, each line is the correct length (number of characters) for the number of reply bytes for the OTU.

2.4.8.16 Test Characters, Key to Press 'T'

Displays a set of characters to test the modes of the display. Not of any real use in maintenance of the Instation, as in normal use the Instation has no display.

2.4.8.17 Reset Free time counters and IMD status indicators, Key to Press 'Z'

Simply resets counters to best condition i.e. 100% free, and IMD cumulative status indicators to 0.

2.4.8.18 Exit

This text shows the combination of keys to press to exit the TC12 software on the PC and return to DOS.

2.4.9 Fuses

Internal Power Supply Fuse on the PSU PCBs

The Power supply fitted to every PSU board used in the system (part number 667/7/22631/000, manufactured by Daren Electronics PLC type PP40-30) is fitted with an Anti surge 1 A, 250 V 20 x 5 mm fuse (part number 518/4/90631/015).

Master Switch Panel Assembly

Figure 16 shows the layout of the Master Switch Panel and RCD. The positions of the fuses are shown.

Figure 17 - Master Switch Panel Fuses

MASTER SW CABINET RCD	FS1	FS2	FS3	FS4	FS5	FS6	FS7
	5A FRONT 13A SKT	5A REAR 13A SKT	5A MAINS SKT B	5A MAINS SKT C	5A MAINS SKT D	5A MAINS SKT E	10A WALL MAP PSU

Master Switch and RCD.

The diagram above shows the layout of the fuses on the Master Switch Panel assembly. The position of the fuses FS1 to FS7 is shown along with the fuse value.

Fuse FS1 protects the front Mains sockets.

Fuse FS2 protects the rear Mains sockets.

Fuses FS3 to FS6 protect the Mains supply to up to four 19" racks.

Fuse FS7 protects the Wall Map power supply, if fitted.

2.4.10 PSU

The part number of the power supply fitted to the PSU board is 667/7/22631/000.

The Instation power supply should be replaced every **five years**, otherwise it may become prone to overheating. There may be a label already on the PSU showing the date it was shipped. This should be covered with a label showing the **date the PSU is fitted** into the equipment. The replacement date is therefore five years **after** the date on the label.

Power Supply Tests

If the power supply is suspected of being faulty, check the voltage outputs of the power supply using a Multimeter.

Slide the PSU Board forward slightly to make access easier.

Wires connect from the power supply to terminal pins on the PCB. The terminal pins are labelled TP4 to TP9 and each is also labelled with a voltage. Check these as follows:

The voltage between TP7, GND and TP5, +5 V should be between 4.75 V and 5.25 V.

The voltage between TP8, AGND and TP4, +12 V should be between 12.6 V and 11.4 V.

The voltage between TP8, AGND and TP9, -12 V should be between -12.6 V and -11.4 V.

2.4.11 Digital Output PCB

The digital output PCB is fitted with four 3.15 A, 250 V Quick Blow fuses (part number 518/4/97023/007), FS1 to FS4. These protect the power supply to the digital outputs.

2.4.12 Recommended Spares

The TC12 Family Tree part number is 667/DZ/22600/000. This shows the structure of part numbers within the TC12 system. The top level part number for the TC12 Instation is 667/1/22600/000.

Description	Part No
Master Switch Panel Fuses:	
Replacement 5 A, 240 V fuse	518/4/90638/000
Replacement 5A Fuse holder (including fuse)	516/4/97053/000
Replacement 10 A, 240 V fuse	518/4/90351/006
Replacement 10A Fuse holder (NO fuse)	516/4/97063/001
PSU PCB - PSU Fuse (1 A, 250 V Anti-surge)	518/4/90631/015
Digital Output PCB Fuses (3.15 A, 250 V Quick Blow)	518/4/97023/007
Modem PCB	
Variant (UK) (overseas)	666/1/02243/000 667/1/02243/000 or 001
Transformer PCB	
Variant (UK) (overseas)	666/1/02245/000 666/1/02245/000 or 001
PSU PCB	666/1/02249/002
PSU PCB Power Supply	667/7/22631/000
Digital Output PCB (ETC is the variant)	666/1/02259/ETC
Wall Map PSU	667/7/22631/000

OPTIONAL SPARES:

Description	Part No
Instation PC	667/7/22609/002
DIGI I/O Card	667/7/22609/004
IMD Distribution Klt	667/7/22665/000
Ethernet Card	667/7/22609/014

3 TC12 OUTSTATION

3.1 SPECIFICATION

3.1.1 Mains voltage ranges

The Outstation will work over: 85 – 264 V RMS

Note the power supply used is auto-ranging over the above voltage range.

3.1.2 Mains frequency range

All TC12 equipment will work from 47 Hz to 63 Hz.

3.1.3 Mains current

OTU rack including four Detector cards 250 mA at 240 V

3.1.4 Temperature and humidity requirements

The OTU will work over -15 °C to 75 °C.

Humidity: 96% at 40 °C non-condensing

3.1.5 Size and Weight

Size:

Height	222.3 mm
Width	482.6 mm
Depth	305.0 mm

Weight 5.4 Kg

NOTE: The weight of the OTU does not include detectors or their backplanes.

3.1.6 Detector Power Supply

The standard OTU PSU can supply 750 mA @ 24 V for detectors.

If a double OTU is fitted the 24 V supply for detectors is limited to 400 mA.

3.2 INSTALLATION

3.2.1 General

Installation and commissioning of the Outstation is carried out in the following order:

- Configure the Outstation PCB via PCB switches
- Install the mechanical assembly

- Connect the cabling
- Configure the Outstation using the Handset terminal

The items that need configuring include:

Output Power Level (Switch S3)
Receive Threshold (Switch S3)
2 or 4 Wire Line Connection (Switch S4)
600 Ω / High Impedance Line Termination (Switch S6)
Instation Communications Method (Jumpers)
Baud Rate / Mode (GMM)
Outstation Address (GAD)
Number of Outstations on the Line (GNO)
Number of Control Bytes for all Outstations on the line (GCW)
Number of Reply Bytes for all Outstations on the line (GRW)
Digital Inputs and Reply Bytes
Fault Flag and Data Displays
LMU Information
Additional Propagation Delay (GPD)

Items (1) to (4) are configured using switches on the Outstation PCB as described in section 3.2.2.3. These switches relate to telephone line communications via modems.

Item (5) is configured using the jumpers on the daughter board fitted to OTUs that require RS232 communications with the Instation – see section 3.2.2.4.

All other items are configured using the handset terminal.

The TC12 Family Tree part number is 667/DZ/22600/000. This shows the structure of part numbers within the TC12 system. The top level part number for the TC12 Free-standing OTU is 667/1/22670/000.

Drawing 667/GA/22670/000 shows the mechanical arrangement of the TC12 OTU. The layout of the mechanical rack and the positions of the OTU PCB, power supply and detector cards are shown.

Note 1: The 11" version of the rack will accept a maximum of four single backplanes. The 19" version of the rack will accept up to 12 single backplanes. The double backplane is now obsolete.

Note 2: If a TC12 OTU is to be fitted into Microsense pole mounted Pelican controller then use kit 667/1/22945/000 that contains the brackets and fixings required.

3.2.2 Configuring the Outstation PCB

Figure 18 and Figure 19 are diagrams of the two variants of Outstation PCB. Figure 18 corresponds to a PCB that operates using a modem communications link only. Figure 19 corresponds to a PCB that is capable of operating with a modem or an RS232 communications link.

The position of the switches, connectors, fuses and status LEDs are shown.

Ensure that the correct variant of the PCB has been supplied.

Figure 18 - OUTSTATION PCB LAYOUT

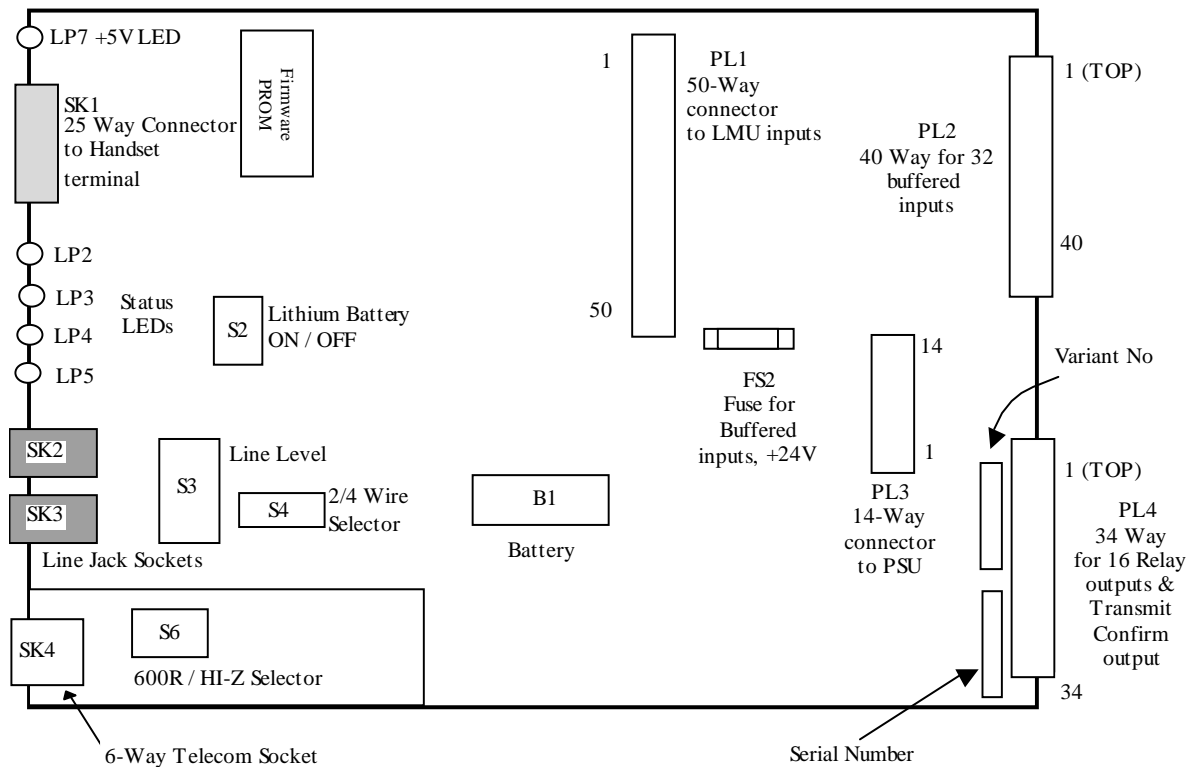
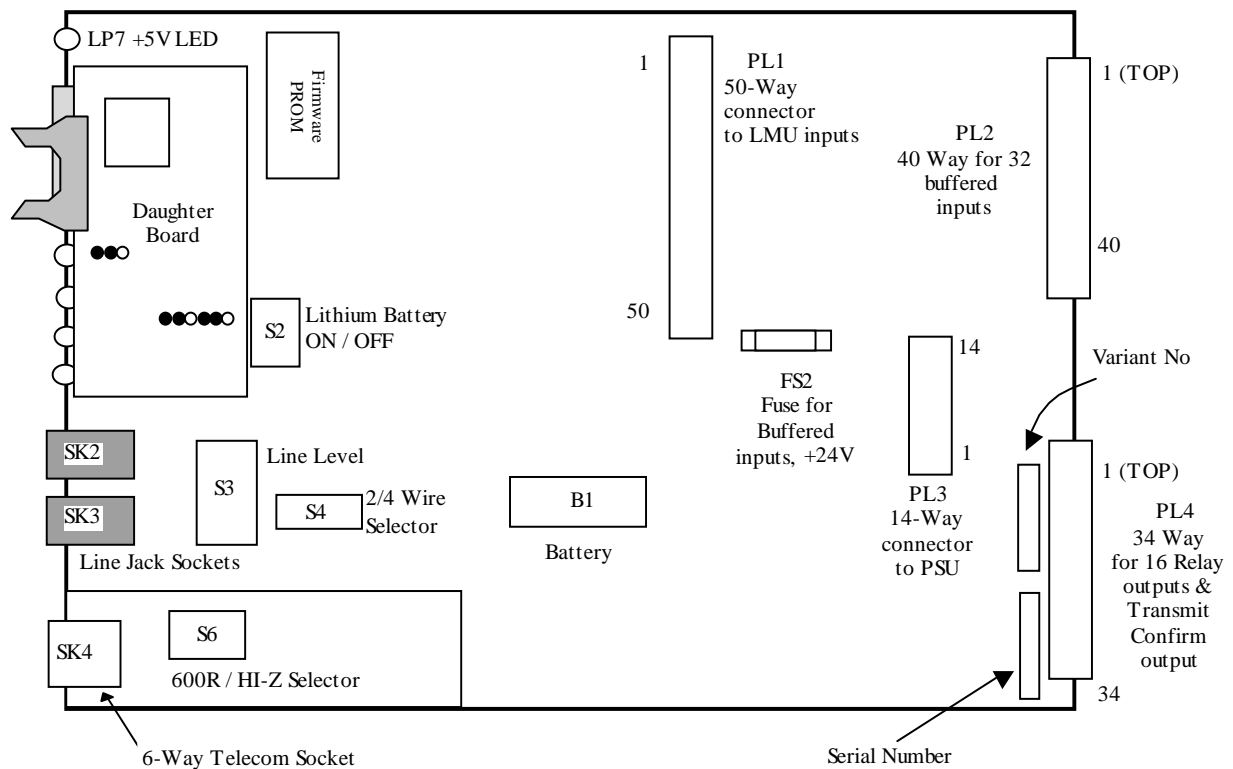


Figure 19 - OUTSTATION PCB and DAUGHTER BOARD LAYOUT



3.2.2.1 Safety Warning

The TC12 Outstation PCB contains a lithium battery, B1 on Figure 18 and Figure 19. Care must be taken with the use and disposal of this battery. The handling precautions in code of practice CP526 must be followed.

3.2.2.2 Cover

The PCB is fitted with a cover (part number 667/2/22610/000 front, /001 rear).

UK Usage

WARNING

FOR UK USAGE THERE ARE NO USER ACCESSIBLE PARTS UNDER THE COVER. REMOVAL OF THE COVER WILL INVALIDATE STC WARRANTY.

Overseas Usage

WARNING

The cover must ALWAYS be fitted before any cables are installed, and should NEVER be removed whilst the telephone cable (from socket SK4 on the PCB) is connected to the telephone network.

3.2.2.3 Configuring the Switches on the Outstation PCB

Before any connectors are attached to the Outstation PCB, the configuration switches need to be set up as described below. Refer to Figure 18 or Figure 19 for the position of the switches on the PCB.

There are four switches on the PCB.

S2 = Lithium Battery On / Off Switch See Figure 20

S3 = Line Level Switch See Table 5

S4 = 2 / 4 Wire Select Switch See Figure 21

S6 = 600 Ω / High Impedance Switch See Figure 22

These are set as follows:

1. Slide the PCB out of the card guides.

2. S2 - Lithium Battery On / Off Switch

Ensure that the Lithium Battery Switch (S2) is set to the ON position.

3. S3 - Line Level Switch

Ensure that the Line Level Switch (S3) is set to the required line levels. These are stated on the installation information sheet for the Outstation. Table 5 shows switch settings corresponding to the different levels. Switch S3 is a 6-way DIL switch. Switch positions 1 to 4 set the Output Power and switch positions 5 and 6 set the Receive Threshold.

For UK use the output power is always set to -13dBm and the receive threshold is set to -39dBm.

No other setting except for -13dBm is to be used in the UK for the output power setting.

4. S4 - 2 / 4 Wire Select Switch

Set the 2/4 Wire Select Switch to the setting indicated on the installation sheet for the Outstation (see Figure 21 for switch positions).

5. S6 - 600 Ω / High Impedance Switch

Installation is to be performed by a qualified / authorised installation / service engineer.

WARNING

THIS SWITCH IS LOCATED UNDER THE PCB COVER. FOR UK USAGE THERE ARE NO USER ACCESSIBLE PARTS UNDER THE COVER. STC WARRANTY WILL BE INVALIDATED IF THE COVER IS LEFT OFF OR MISSING.

This switch is always set to the 600 Ω position for all Radial, Multi Point and/or Multi Terminal lines. The switch is set to 600 Ω during manufacture and therefore does not need to be changed. Where British Telecom or other telephone line supplier has agreed to provide Multi-drop circuits i.e. where more than one OTU is to be connected to one line, the final OTU on the line is set to 600 Ω , all others on the line need to be set to high impedance. Then the switch may be set as appropriate for the OTU, as noted below. This also applies to dual OTUs where both OTUs are connected to the same line - only **one** of the OTUs may be set for 600 Ω if appropriate. The switch on the other OTU should be set to high impedance.

Note to Service / Installation engineers:

This switch is located underneath the cover. The top half of the cover should be removed in order to set the switch. No cabling should be connected at this stage, but before removing the cover make sure that the cable connected to socket SK4 of the PCB is not connected to the telephone network. Ensure the cover is re-fitted correctly after setting the switch. See Figure 21 for switch settings. Make a note of the switch setting on the OTU installation sheet for future reference.

6. The PCB can now be replaced back in the card guides.

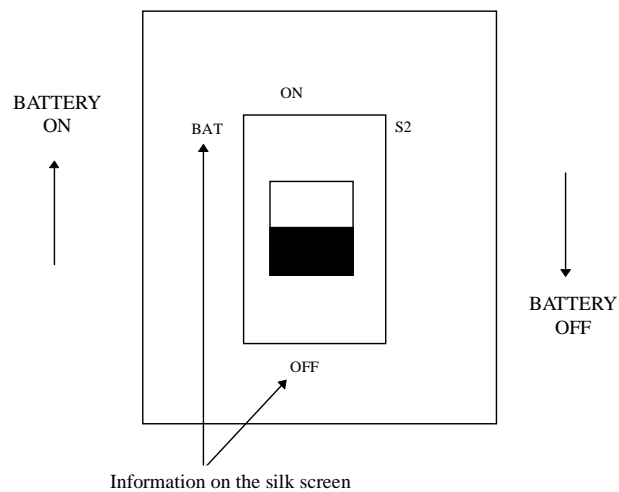


Figure 20 - OTU Lithium Battery On / Off Switch (S2)

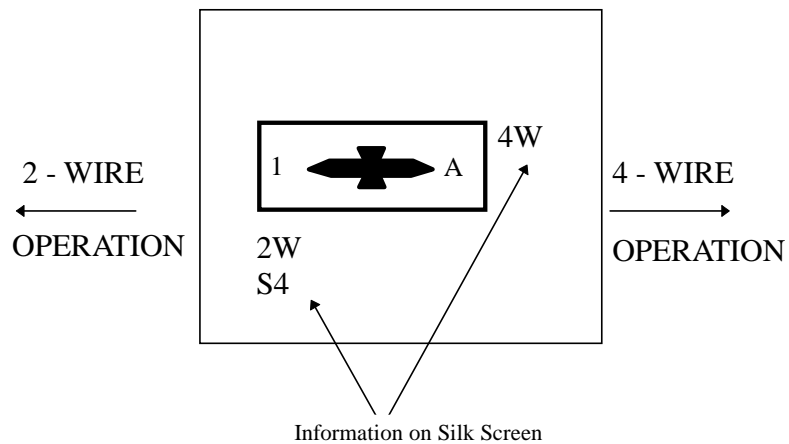


Figure 21 - OTU 2/4 WIRE SELECT SWITCH (S4)

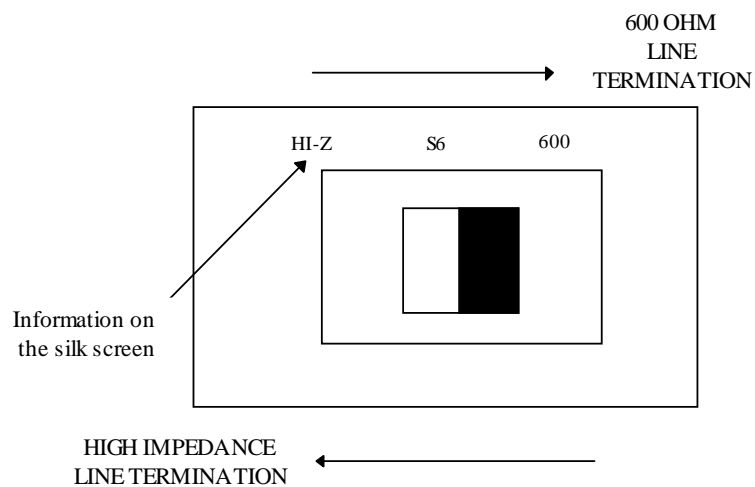


Figure 22 - OTU 600 Ω High Impedance Switch (S6)

Table 5 - OTU Line Level Switch (S3)

OUTPUT POWER	SWITCH NUMBERS					
	1	2	3	4	5	6
0 dB	1	0	0	0	SEE BELOW ↓	
-3 dB	1	0	0	1		
-6 dB	0	1	0	0		
-9 dB	0	1	0	1		
-10 dB	0	0	1	0		
-13 dB	0	0	0	0		
-16 dB	0	0	0	1		
RECEIVE THRESHOLD	SEE ABOVE ↑				↑	
-42 dB						
-39 dB						
-33 dB						

 = Setting for the UK

0 = Switch Open

1 = Switch Closed

3.2.2.4 Configuring the Jumpers on the Outstation PCB Daughter Card

A daughter card must be factory fitted to the Outstation PCB (see Figure 19) where RS232 communications to an Instation is required. RS232 or normal telephone line communications via modems is selectable with the daughter card fitted.

There are 3 jumper triples (LK1, LK2 and LK3) on the daughter card. The jumpers must be selected as in Figure 23.

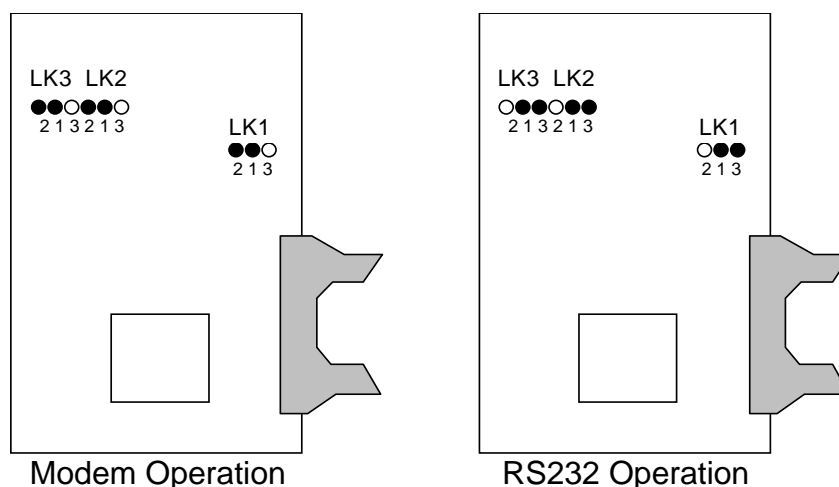


Figure 23 - Modem Daughter Card Jumper Positions

The GRX handset command (see section 3.3.3.8) must be used together with the above jumper positions in order to activate the desired communications interface.

3.2.3 Connectors and Cables

3.2.3.1 PSU Cable - OTU and Detectors

Connect the PSU cable (part number 667/1/22690/000) to the Outstation PCB. This cable connects from the power supply to the 14-way connector, PL3 on the PCB.

2 wires from the Molex connector at the PSU are used to connect to the detectors. The Brown wire is +24 V and the Blue wire is the 0 V. These connect to the first detector nearest to the power supply. Additional detectors are supplied with 24 V by 'daisy chaining' wires from the first detector.

NOTE. Do not connect/disconnect the cable whilst the power is switched on.

3.2.3.2 Mains Cable

The mains cable (part number 508/4/27193/000) should be wired into the mains distribution panel of the traffic controller. There is no separate on/off switch on the Outstation.

3.2.3.3 Telephone Cable with 6-way Plug

The OTU comes fitted with a telephone cable terminated in a 6 way telecom plug. Connect the telephone plug to the telephone socket in the traffic control equipment.

[For information only - the other end of the telephone cable attaches to SK4 on the PCB underneath the cover. Connection at the network termination unit uses either 2 or 4 wires. The wire colours/functions for the 2 and 4 wire cases are shown in Figure 24].

Note The cable should never be disconnected from the PCB Socket (SK4) whilst the other end is connected to the telephone network (via the network termination unit). In order to prevent the cable being disconnected from the PCB by accident, the release lever on the 6-way plug that connects to Socket SK4 is cut off. The top PCB cover also fits around the end of the plug.

Ferrite Core

The telephone cable comes fitted with a ferrite core (the cable is passed twice through the core (part number 905/4/10615/000), close to the PCB end of the cable).

The ferrite core should be cable tied to a suitable point in the traffic controller, or a suitable place on the OTU mechanics (e.g. on top of the detector racking), if it is likely to interfere with the controller door or any other installed equipment.

Figure 24 - OTU 6-Way Telecom Socket Connections

OUTSTATION PROCESSOR PCB - SKT4

6 - Way Telecom Socket to MDF

PIN	2-Wire Selected	4-Wire Selected
1	TX Transmit Reply Data	TX+ Transmit Reply Data
2	NC	RX+ Receive Control Data
3	NC	NC
4	NC	NC
5	NC	RX- Receive Control Data
6	RX Receive Control Data	TX- Transmit Reply Data

The telephone cable connects to the socket above via a 6-way plug. The wire colours on this cable, which connect to the above pins, are as follows:

PIN 1	BLACK WIRE
PIN 2	WHITE WIRE
PIN 3	GREEN WIRE
PIN 4	BLUE WIRE
PIN 5	RED WIRE
PIN 6	ORANGE WIRE

3.2.3.4 RS232 Cable

The RS232 cable (667/1/22611/000) supplied with the OTU has flying leads at the data transmission end of the cable and a keyed 14-way Berg connector at the OTU end of the cable.

The OTU to data transmission system serial interface complies with RS232 at the OTU connector using the signals and pin allocations defined in the following table.

Name	Direction	Pin	Notes
TX	From OTU	6	Transmit Data
RX	To OTU	10	Receive Data
RTS	From OTU	7	Request to Send - activated by the OTU when it has data ready for send to the data transmission system
CTS	To OTU	9	Clear to Send - activated by the data transmission system in response to RTS from the OTU - see note 1
CD	To OTU	8	Carrier Detect - activated by the data transmission system in response to a carrier signal - see note 2
DSR	To OTU	-	Not used
DTR	From OTU	5	Data Terminal Ready - see note 3
GND	-	4	Signal Ground

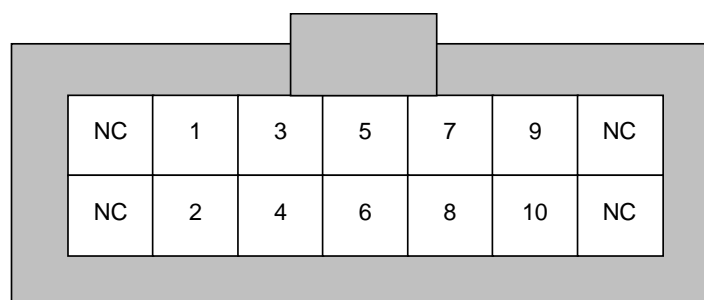
NOTES

1. If the data transmission system cannot provide CTS then the cableform between the OTU and the data transmission system is to provide an RTS / CTS loopback at the OTU.

2. CD may or may not be provided by the transmission system. It is important that if CD is provided then it is activated 8ms prior to the start of received data. If the data transmission system cannot provide CD then GRX=1 handset command should be used.

3. The DTR signal is maintained at an active state by the OTU at all times except when the modem mode is changed e.g. GMM handset command. The OTU does not check for the OTU modem asserting DSR in order to start data transfer to the Instation.

The Berg connector pin out viewed from the front of the connector (socket side) is shown below.



NC = not connected.

3.2.3.5 Input/Output Cable

Connect the Input/Output Cable (part number 667/1/22693/000) to 40-way connector PL2 and 34-way connector PL4.

Note. When pushing the connectors into PL2 and PL4 the OTU PCB must be supported from underneath to stop the board from bending and possible damage being caused.

Refer to Drawing 667/GA/22693/000 for wire colours of particular inputs and outputs (inputs are labelled R1, R2, etc. and outputs are labelled C1, C2, etc.).

Figure 25 and Figure 26 show the pin out of the input connector (PL2) and (PL4) on the PCB.

Outputs - Each output has two wires. It does not matter which way round these are connected. Outputs 1 to 8 and Transmit Confirm (labelled TC) extend from the thicker multi-core cable (labelled 11 on the drawing). Outputs 9 to 16 extend from the thinner multi-core cable (labelled 10 on the drawing).

Inputs - Inputs 1 to 8 extend from the thicker multi-core cable (labelled 11 on the drawing). Inputs 9 to 16 extend from the thinner multi-core cable (labelled 10 on the drawing). The ground for each of these 16 inputs is wired as follows:

A white wire from the thicker multicore cable is paired with one end of a looped white wire. This pair of wires should be connected together to provide the ground for one of the inputs. Fifteen other input grounds are formed by the looped white wire.

Individual wires provide inputs 17 to 24 directly from the 40-way Berg connector (Refer to cable drawing). These inputs are for use with the detectors. A single white ground wire is included with the individual wires from the 40-way connector. This should be wired to the input ground of the first detector and 'daisy chained' to the other detectors.

Individual wires also provide inputs 25 to 32 directly from the 40-way Berg connector (Refer to cable drawing).

Inputs on 40 way connector PL2 are also used to connect voltage sensors when these are required for lamp monitoring (see section 3.2.5).

The inputs conform to MCE0141, i.e. an impedance of less than 250 ohms to ground will deactivate the input and an impedance of greater than 100K to ground will activate the input.

Figure 25 - Outstation Input Connections

OUTSTATION PROCESSOR PCB - PL2

40-way connector to buffered inputs.

PIN	NAME	NOTES
1	Input 1	
2	Input 2	
3	Input 3	
4	Input 4	
5	Input 5	
6	Input 6	
7	Input 7	
8	Input 8	
9	Input 9	
10	Input 10	
11	Input 11	
12	Input 12	
13	Input 13	
14	Input 14	
15	Input 15	
16	Input 16	
17	Input 17	
18	Input 18	
19	Input 19	
20	Input 20	
21	Input 21	
22	Input 22	The +24 V supply to the buffered inputs is fused by a 500 mA quick blow fuse (FS2).
23	Input 23	
24	Input 24	
25	Input 25	
26	Input 26	
27	Input 27	
28	Input 28	
29	Input 29	
30	Input 30	
31	Input 31	
32	Input 32	
33	Input GND	
34	Input GND	
35	NC	
36	NC	
37	NC	
38	NC	
39	NC	
40	NC	

Figure 26 - Outstation Output Connections

OUTSTATION PROCESSOR PCB - PL4

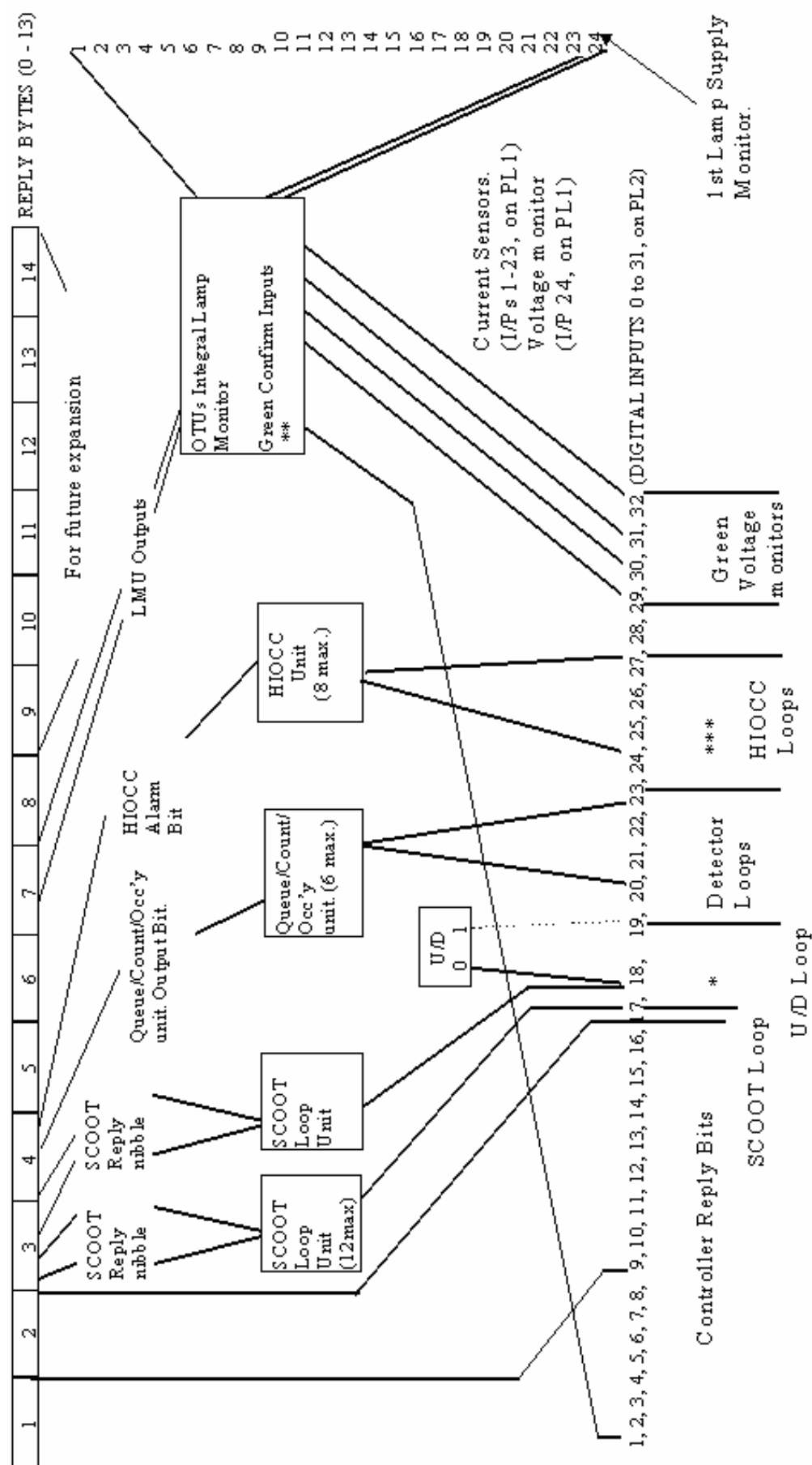
34-way connector to Relay Outputs.

PIN	NAME
1	Output 1
2	
3	Output 2
4	
5	Output 3
6	
7	Output 4
8	
9	Output 5
10	
11	Output 6
12	
13	Output 7
14	
15	Output 8
16	
17	Output 9
18	
19	Output 10
20	
21	Output 11
22	
23	Output 12
24	
25	Output 13
26	
27	Output 14
28	
29	Output 15
30	
31	Output 16
32	
33	Transmit Confirm Relay Output
34	

3.2.3.6 Connection of SCOOT Detector Inputs to Free-Standing TC12 OTU

On a free-standing TC12 OTU, the SCOOT detector inputs to the OTU should be connected to the normally closed contacts on the detector backplane. On an STC detector back plane these are the odd numbered pins starting at pin 9.

Figure 27 - Freestanding Outstation Inputs



* Leading U/D loop is assigned to any input (e.g. GUD0=19) and the 2nd input is assigned automatically by the software. Therefore it is only necessary to assign one U/D input to the digital inputs, 1 to 31. Up to 4 U/D inputs can be used.

*** G Bits used as green confirms where possible.

**** Up to 8 High Occupancy loops can be used. Each HIOCC unit will require one bit on the Reply word.

3.2.4 Lamp Monitor Unit Connections

NOTE. RED LAMP MONITORING is not approved by the Department of Transport and should not be used.

If the installation uses the lamp monitoring facility then Current and voltage monitoring transformers are connected to PL1 on the OTU PCB via a 54-way connector housing (part number 508/4/26138/004). The current and voltage monitor transformers have two wires each, terminated in crimps that push in to the connector housing.

Note - only 50 positions are used on the 54 way housing. Positions 1, 2, 53 and 54 are unused, as they do not line up with any of the 50 pins on plug PL1.

Figure 28 shows the pin out of PL1. LMU input 1+ and LMU input 1- (PL1 pins 1 and 2), correspond to positions 3 and 4 respectively on the 54 way housing. ZXO input + and ZXO input - (PL1 pins 49 and 50), correspond to positions 51 and 52 respectively on the 54 way housing.

Note - LMU Input 24 (pins 47 and 48) is internally connected to the ZXO input (pins 49 and 50). The voltage monitoring transformer can therefore connect to either LMU input 24 or the ZXO input. Whichever input is used, the other input must not be used for anything else. Under the voltage monitoring transformer heading, later in this section the description explains how to connect to the ZXO input; if this is used LMU input 24 must be left unconnected.

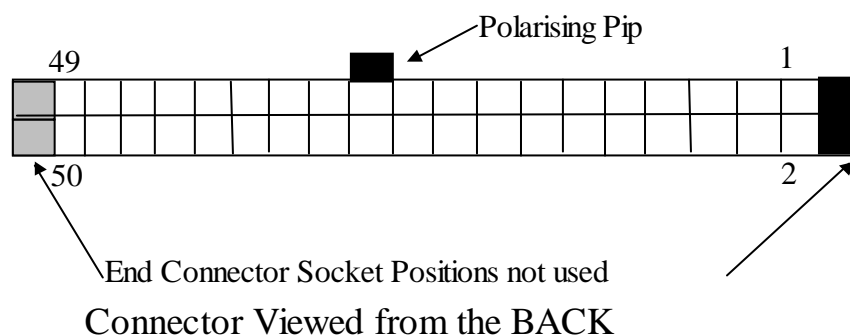


Figure 28 - LMU Input Connector

Table 6 - Outstation Processor PCB - PL1

50-way connector to LMU inputs.

PIN	NAME	PIN	NAME
1	LMU Input 1+	27	LMU Input 14+
2	LMU Input 1-	28	LMU Input 14-
3	LMU Input 2+	29	LMU Input 15+
4	LMU Input 2-	30	LMU Input 15-
5	LMU Input 3+	31	LMU Input 16+
6	LMU Input 3-	32	LMU Input 16-
7	LMU Input 4+	33	LMU Input 17+
8	LMU Input 4-	34	LMU Input 17-
9	LMU Input 5+	35	LMU Input 18+
10	LMU Input 5-	36	LMU Input 18-
11	LMU Input 6+	37	LMU Input 19+
12	LMU Input 6-	38	LMU Input 19-
13	LMU Input 7+	39	LMU Input 20+
14	LMU Input 7-	40	LMU Input 20-
15	LMU Input 8+	41	LMU Input 21+
16	LMU Input 8-	42	LMU Input 21-
17	LMU Input 9+	43	LMU Input 22+
18	LMU Input 9-	44	LMU Input 22-
19	LMU Input 10+	45	LMU Input 23+
20	LMU Input 10-	46	LMU Input 23-
21	LMU Input 11+	47	LMU Input 24+
22	LMU Input 11-	48	LMU Input 24-
23	LMU Input 12+	49	ZX0 Input +
24	LMU Input 12-	50	ZX0 Input -
25	LMU Input 13+		
26	LMU Input 13-		

3.2.5 Current Transformer Ratings

Each controller phase or illuminated indicator that is to be monitored requires one current sensor 667/7/25171/000 as detailed below. The table also indicates which lamp feeds are passed through the current sense transformer for each type.

Monitorable lamp/phase types	Current sensor lamp feeds	Maximum number of Signal Heads (see note 1)
Intersection Vehicle (IV)	Red, Amber, Green	8 { 3 }
Pelican Vehicle (PV)	Red, Amber, Green	16 { 6 }
Intersection Pedestrian (IP)	Red man, Green man	16 { 6 }
Pelican Pedestrian (PP)	Red man, Green man	16 { 6 }
Wait Indicator 40 Watt (W4)	Wait Indicator(s)	16 { 6 }
Wait Indicator 60 Watt (W6)	Wait Indicator(s)	16 { 6 }
Regulatory Sign (RS)	Sign	7 signs (21 tubes) 2 signs (6 tubes)}
Switched Sign - Bulb type (SB)	Sign	16 lamps {6 (note 5)}
Switched Sign - Tube type (ST)	Sign	7 signs (21 tubes) {2 signs (6 tubes) note 5
Pelican Pedestrian + Wait (PPW / PP4)	Red man, Green man,	16 (note 2) { 6 }
Pelican Stream (PS / PS4)	Wait Ind Red, Amber, Green, Red man, Green man, Wait Ind	16 (note 3) { 6 }
Intersection Pedestrian + Wait (IPW / IP4)	Red man, Green man, Wait Ind	16 (note 2) { 6 }
Intersection Pedestrian Stream (IPS / IS4)	Red, Amber, Green, Red Man, Green man, Wait Ind	8 (note 4) { 6 }
Export Pedestrian with flashing Red (XP1)	Red man, Green man	16 { 6 }
Export Vehicle with flashing Green (XV1)	Red, Amber, Green	8 { 3 }
Export Vehicle Filter - flashing Amber Ball (XV2)	Flashing Ball	16 { 6 }
Export Vehicle - flashing Amber signal group (XV3)	Red, Amber, Green	8 { 3 }

Notes:

These limits apply to 240 V RMS supply voltage and 50W lamp loads (unless stated). Where the supply is lower or the lamp loads are higher the limits are reduced accordingly. For example the figures given in curly brackets {}, are the

maximum loads when a 50-0-50 V RMS mains supply is used. The limits are only reduced if the actual voltage being monitored is at the lower level, i.e. if a 50-0-50 V RMS supply (derived from a transformer) is used but the monitoring is on the 240 V RMS side of the transformer, then the limits do not need to be reduced.

If the nominal load current (including red/ambbers) of a particular controller output exceeds 4.0 A RMS, at nominal mains voltage, then that output should be split and treated as two separate outputs (although the same voltage sensor can be used for both).

For example, 8 pedestrian plus 8 wait indicator.

For example, 8 vehicle plus 4 pedestrian plus 4 wait indicator.

The limit of 8 applies if they are all vehicle signals. For fewer than 8 vehicles the limit is greater, i.e. 6 vehicle plus 2 pedestrian plus 2 wait indicator.

To allow monitoring of tube type signs at 50-0-50 V sites, the signs must be driven with the 50-0-50 V supply and the tubes must have the standard voltage-current characteristic.

CAUTION The current sensors may produce a high voltage, when not terminated into the OTU board, if current is passed through the core.

The Current transformers measure the current flowing in conductors that are passed through their core. To maintain the correct relationship between the current flowing in the conductors and the output from the sensor, the sensors must be connected the correct way round.

The current transformers are toroidal and one side is marked with a red spot to indicate the input direction. The Live conductor(s) should pass from the controller output terminal(s) through the centre of the current transformer, entering the side with the red spot marker, and on to the lamp(s).

The output wires from the current transformer are red (positive) and white (negative) and are terminated with Berg mini PV terminals which are clipped into a Berg mini latch housing to provide a complete sensor assembly which plugs into PL1 on the OTU board. Referring to Figure 35, the red wire connects to the required number LMU input shown with a +, and the white wire connects to the corresponding - input. Inputs should normally be allocated consecutively starting from number 1. The current sensors should then be anchored by passing a TYWRAP or equivalent through the sensor hole and around a suitable fixing point.

Up to 23 current transformers can be used per Outstation when equipped with LMU facilities.

Voltage Monitoring Transformer

A Voltage monitoring transformer (part number 667/7/25172/000) is used per Outstation when equipped with LMU facilities. The red and black wires connect to the lamp supply mains live and neutral being monitored (Red to Live and Black to Neutral). The orange and white output wires connect to PL1. Referring to Figure 35 the orange wire connects to pin 49 (ZXO Input +) and the white wire connects to pin 50 (ZXO Input -. LMU Input 24, pins 47 and 48, is internally connected to the ZXO input, pins 49 and 50, see note earlier in this section).

The sensor should then be anchored to a suitable point in the cabinet (using the grooves on the sensor as a guide).

Monitoring Dual Controllers

A facility to monitor two controllers operating from a common mains supply is provided (e.g. for use with some dual pelican controllers). The voltage monitoring and current sense transformers for the first controller are connected as described above. When all these have been allocated the next available input is used for the second controller voltage monitor transformer. This input will be configured as the second supply voltage monitoring input (see handset commands). The current sense transformers for the second controller are then connected consecutively to the remaining input numbers.

Note: The above arrangement does not provide independent monitoring of each controller. Switching the lamps off on the first controller will stop all monitoring. If this is not acceptable an alternative configuration is available:

Connect an unswitched mains supply to the first voltage monitoring transformer (output to PL1 pins 49 and 50).

Connect the first controller lamp supply monitor to PL1 input 1, and configure this input as not monitored.

Proceed as described above - starting controller 1 current inputs at PL1 input 2.

Voltage Sensors

With the exception of the regulatory signs, each controller output that is to be monitored requires a means of determining the state of the green lamp drive voltage for that output. For single aspect outputs (e.g. switched signs) the state of the drive to the monitored aspect is required. In the case of Red lamp monitoring there is an additional requirement for a red lamp mains state indication.

For normal lamp monitoring (NOT RED LAMP MONITORING) there are two possible methods of obtaining the mains state inputs.

a) Using suitably configured green confirm outputs from the controller. The output is connected to the appropriate input on PL2.

Note: It may not be possible to use stage confirm bits if the following situations exist:

Phase overlaps from one stage to another.

Staggered phase introduction due to phase delays or intergreens.

Leaving phase delays.

Use of phases that are not fixed in the stage.

b) Using voltage sense transformers to produce a suitable logic signal direct from the lamp drive voltage.

Note: If voltage sensors are used to monitor a dimmed 50-0-50 V RMS supply (on the 50-0-50 V RMS side of the transformer), they will only work down to the first dim voltage tapping (i.e. dimming to 66% of the nominal undimmed voltage). The voltage sensors will not work with lower voltage tappings.

If Voltage sense transformers (part number 667/1/22734/000) are used then these connect to inputs as follows. There are four wires from the voltage sensors. Two wires connect to the mains lamp drive voltage being monitored (Blue wire to neutral, Brown wire to live). The white and black wires connect to the required input on 40-way connector PL2. Connector PL2 has Input/Output cable (667/1/22693/000) connected to PL2 (as described in section 3.2.5). Using a suitable terminal block connect the white (ground) wire of the voltage sensor to the white (ground) wire on the Input/Output cable and connect the yellow wire on the voltage sensor to the appropriate coloured wire on the Input/Output cable (corresponding to the required input number).

The voltage sensors should then be fastened (e.g. Tywrap) to a suitable point in the cabinet, such as the cabinet cross-member or other free unobtrusive rail or wire bundle.

Ferrite Clamp

A Ferrite clamp (part number 905/4/10616/000) is fitted over all wires from the 50 way connector, PL1, as close to PL1 as possible. The ferrite clamp should be cable tied to a suitable point on the OTU mechanics to prevent it moving.

3.2.6 Lamp Monitor Unit - Number of Current and Voltage Sensors

LMU Configuration

Before the detailed configuration of an installation takes place, it is often necessary to calculate the number of current and voltage sensors required. Tables to assist with this are given on the next page. To use these, fill in the appropriate information in the spaces provided and a final addition/subtraction of the values will give the number of sensors required.

Number of Current Sensors

Number of phases (include vehicle, green arrow and pedestrian phases)	+___
Number of pedestrian phases with wait indicators	+___
Number of switched sign drives	+___
Number of separately monitored regulatory sign drives	+___
Add one for each monitored load above 4A rms	+___
Subtract one for each wait indicator to be monitored by the same current sensor as the pedestrian phase	+___
Subtract one for each pedestrian phase to be monitored by the same current sensor as the opposing vehicle phase	+___
Total current sensors	=___

Number of Voltage Sensors

Number of phases (include vehicle, green arrow and pedestrian phases)	+___
Number of pedestrian phases with wait indicators	+___
Number of switched sign drives.	+___
Subtract one for each phase green state which coincides with a green confirm reply available from the controller	+___
Note: This is only applicable where Red Lamp Monitoring is not required.	
Subtract one for each wait indicator state that coincides with a wait confirm reply available from the controller	+___
Add one for each vehicle phase with Red Lamp Monitoring	+___
For export lamp monitoring only:	
Add one where the controller can enter flashing red/amber mode	+___
Note: Not needed if a signal indicating flash mode active is available from the controller.	
Add one for each flashing amber signal group	+___
Total voltage sensors	=___

3.2.7 TC12 Outstation Mechanical Modules and Number of Detectors Supported

There are five separate mechanical modules available for the TC12 Outstation. These are listed below the top level part number 667/1/22670/000, and are as follows:

Part number	Description	Maximum No. of detector backplanes
667/1/22691/000	Module Assembly for OTU only	no detector racking
667/1/22691/001	Module Assembly for OTU and Detectors for use in 11" racking	4
667/1/22691/002	Module Assembly for OTU and Detectors for use in 19" racking	12
667/1/22691/003	Module Assembly for Dual OTU and Detectors for use in 19" racking	10
667/1/22691/004	Module Assembly for OTU for use in 19" racking	no detector racking

Single Detector Backplane part number is 667/1/15990/003.

Note that the double detector backplane (667/1/15990/002) is obsolete.

3.3 COMMISSIONING

3.3.1 Safety Tests on the TC12 Outstation

3.3.1.1 Test Equipment

Multimeter (e.g. Fluke 77 or similar).

Comark Insulation Meter 1905 (or similar capable of 1000 V).

Clare R133R10 Earth Continuity Tester (or similar).

RCD Tester (e.g. Seaward RC500).

3.3.1.2 Safety Considerations

Statutory and Company legislation relating to safety must be followed. During testing hazardous voltages will be present, only qualified personnel are allowed to operate the equipment with hazardous voltages present.

ELECTRIC SHOCK RISK

Hazardous voltages are present within the equipment - observe any warning labels and do not remove any protective covers.

3.3.1.3 Pre-Test Inspection

Check that the correct fuses are fitted to the Outstation (see section 3.4.4 for a description of the fuses fitted to the Outstation).

3.3.1.4 Outline of Tests to be Performed

The sequence of tests will be:

- (1) Earth Continuity Check.
- (2) Insulation Check (1000 V DC Test).

3.3.1.5 Earth Continuity/Insulation Resistance Test Set Up

The Outstation is not wired to the mains during these tests; however make sure that the Outstation mains plug is fully pushed into the Outstation mains socket with the unconnected wires on the other end of the mains cable accessible.

3.3.1.6 Earth Continuity Test Procedure

Connect one probe of the Earth Continuity Tester to the Earth wire of the Outstation mains lead. Connect the other probe to the following points (it may be necessary to find a suitable place to test without paint) and make sure the reading is below 0.5 Ohms:

PCB Mounting plate

PCB Frame

Rack Cross members

Rack Side plate

Case of power supply

Power supply 0 V (pin 4 on OTU PSU 14-way connector, see Figure 18).

All earthed points on any other equipment that may have been attached to the OTU mechanics.

3.3.1.7 Insulation Resistance Test Procedure

Safety Note

Personnel should take care that they do not come into contact with the high voltages generated by the Test Instrument.

Make sure that the Outstation is not connected to the mains but that all fuses are in place and that the PCB is connected.

Make sure that the Outstation mains plug is fully pushed into the Outstation mains socket.

Set the insulation meter to 1000 V DC.

Connect the LIVE and NEUTRAL of the Outstation mains wire together.

Connect the meter to measure between the Outstation mains wire EARTH and the combined LIVE and NEUTRAL.

Allow the meter reading to settle during the test.

The insulation resistance should be not less than 10 MOhm.

3.3.2 Commissioning Procedure after Power Up

Check that the power LED (LP7) comes on when the Outstation is powered up.

Note: If the system fault LED lights on power up (see section 3.4.1 for LED positions) then switch the Outstation off. Make sure the lithium battery switch on the PCB is in the on position and then power the Outstation back up again.

Configure the Outstation using a handset terminal connected to the 25-way 'D' type connector, SK1, on the PCB. See section 3.3.3 for an explanation of commands that need to be entered.

If required the wiring of OTU inputs and outputs (cable 667/1/22693/000) can be checked as follows:

Checking OTU Output wiring:

Attach a handset to the controller and enter controller handset commands that display the status of the 16 controller inputs. Attach a handset to the OTU and enter handset commands to set different output bit patterns on the OTU outputs. Ensure that the controller inputs displayed on the handset

terminal connected to the Controller are in the correct position and are the correct value.

Checking OTU Input wiring:

Attach a handset to the controller and enter controller handset commands to set the status of the 16 controller outputs. Set different output bit patterns on the controller handset terminal. Attach a handset to the OTU and enter commands to display the status of the OTU inputs. Ensure that the OTU inputs displayed on the OTU handset terminal are in the correct position and are the correct value.

Alternatively the OTU I/O cable wiring can be checked using the outstation test set as described in section 5.

Check that the status LEDs illuminate correctly; see section 3.4.1.

3.3.3 Configuration Using the Handset

Note: Configuration of the OTU is also possible using IPT1. Refer to IPT handbook for instructions.

With the OTU powered up connect a handset terminal needs to be connected. Once connected the handset will display the sign on message 'SIEMENS OTU' and commands can then be entered to configure the OTU.

The PC in the TC12 Instation Test Set can be used as a handset terminal - refer to section 4.7. The PC keyboard makes entry of commands easier than with a conventional handset terminal. Alternatively a conventional handheld handset terminal (the same type as used to configure controllers; part number 667/4/13296/000) can be used.

If the OTU is newly installed at the site or is a replacement unit it is necessary to perform a full OTU reset to clear any previous configuration data.

The descriptions of the handset commands listed below are arranged, as far as possible, in functional groups in the order that they should be entered to configure the OTU.

Note: Curly brackets {} in a command indicate numbers that are stated on the Outstation Information Sheet. Curved brackets () after configuration items indicate the default configuration value.

Commands to enable handset access and reset Outstation

3.3.3.1 Write access enable (GME, KME)

GME=???

Comment: Enable write access to OTU data. This is required to change any configuration data in the OTU.

3.3.3.2 OTU reset (CNN, LRN, TKE)

(1) **CNN=???**

(2) **LRN=???**

(3) **TKE=???**

Comment: The above reset commands may be entered in any order, the reset is actioned by switching the OTU power off for a few seconds then re-applying power. On restart the default OTU configuration data will replace all existing configuration data.

Commands to set up communication with the Instation GAD, GMM, GNO, GCW, GRW

3.3.3.3 OTU address (GAD)

GAD={address of OTU: 0 to 14 (0)}

Comment: Address of the OTU being installed.

3.3.3.4 Baud rate/Modem mode (GMM)

GMM={Baud rate/mode: 0 to 24 (6)}

Comment: Code that configures the appropriate baud rate and modem mode.

6 = 1200 Baud half duplex
8 = 600 Baud half duplex
22 = 1200 Baud full duplex
24 = 600 Baud full duplex

Other codes are available, but consult STC before use:

E.g. 5 = 300 baud half or full duplex
7 = 1200 baud half duplex with equaliser
23 = 1200 baud full duplex with equaliser.

3.3.3.5 Number of OTUs (GNO)

GNO={Number of OTUs on the line: 1 to 15 (1)}

3.3.3.6 Number of control words (GCW)

GCW{OTU Address: 0 to 14}={No. of control words for OTU: 0 to 3 (2)}

Comment: The above command is repeated for each OTU on the telephone line. For each OTU enter its address and the number of control words it uses.

3.3.3.7 Number of reply words (GRW)

GRW{OTU Address: 0 to 14}={No. of reply words for OTU: 0 to 14 (4)}

Comment: The above command is repeated for each OTU on the telephone line. For each OTU enter its address and the number of reply words it uses.

3.3.3.8 Receive Data Control Mode (GRX)

GRX= {Control Mode: **0 or 1** (0)}

Comment:- Instructs the OTU to use the CD control line to detect the start and end of receive data from the instation (0) or ignore the CD control line and use a gap timer instead to detect the start of the receive data from the instation (1).

The CD control line is used for telephone line communications using modems.

The gap timer is used for RS232 serial link communications.

3.3.3.9 Additional Propagation Delay (GPD)

GPD= {Delay: **0 to 90** (0)}

Comment:- Instructs the OTU to include an additional number of milliseconds of propagation delay to its calculations.

Propagation delay is considered to be the time from a signal transition being made on the OTU UART Tx line to the same transition being presented at the Instation UART Rx line (or vice versa).

3.3.3.10 Enable/Disable OTU control and reply facility (GOE)

GOE=1 (0)

Comment: Causes the OTU UTC control and reply function to be enabled (1) or disabled (0). The facility should not be enabled until all the required configuration items have been set up and checked.

Commands to set up digital inputs and reply bytes **GSA, GUD, GRL, GIS**

3.3.3.11 SCOOT loop input allocation (GSA)

GSA{Scoot loop no.: **0 to 11**}={Digital input no.: **0 to 31**} (255)

Comment: Repeat this command for up to 12 scoot loops. For each scoot loop used enter the number of the scoot loop and the input (on Buffered Input Connector PL2 see section 3.2.3.5) to which its detector output signal connects.

Note. The 32 inputs are numbered 1 to 32 in section 3.2.3.5, corresponding to the associated pin on the 40 way input connector, however the handset command numbers the inputs from 0 to 31, for the 32 inputs.

3.3.3.12 Unidirectional loop allocation (GUD)

GUD{U/D loop no.: **0 to 3**}={Digital input no.: **0 to 30**} (255)

Comment: Unidirectional loop allocation on a free standing OTU. Repeat this command for up to four unidirectional loops. For each unidirectional loop used enter the number of the loop (0 to 3) and the input (on Buffered Input Connector PL2 see section 3.2.3.5) to which the

normal direction loop connects (the reverse direction loop is connected to the next input after the normal direction loop).

Note. The 32 inputs are numbered 1 to 32 in section 3.2.3.5, corresponding to the associated pin on the 40 way input connector, however the handset command numbers the inputs from 0 to 31, for the 32 inputs.

The controller provides U/D for an Integral OTU. See the Controller Handset Commands CUD and UDT. Note: These functions only work if they are enabled in the T400's configuration.

3.3.3.13 Reply bit function (GRL)

GRL{Reply byte no.: **0 to 13**} {bit no.: **0 to 7**}={function: **0 to 255**} (0)

Comment: For each reply byte set up the function of each bit in this reply byte. This command is therefore repeated up to eight times for each reply byte. The {function} field defines the source that sets the bit, or in the case of SCOOT loops a group of four bits.

The various functions are as follows:

- 0 = For GRL command, this indicates that the reply bit is driven directly. For GOL command, this indicates that the output bit is driven directly from the corresponding UTC control bit.
- 1 = Red Lamp Monitor group 0 - first red fail (RL1)
- 2 = Red Lamp Monitor group 0 - second red fail (RL2)
- 3 = Red Lamp Monitor group 0 - any lamp fail (LF)
- 4 = Red Lamp Monitor group 1 - first red fail
- 5 = Red Lamp Monitor group 1 - second red fail
- 6 = Red Lamp Monitor group 1 - any lamp fail
- 7 = Red Lamp Monitor group 2 - first red fail
- 8 = Red Lamp Monitor group 2 - second red fail
- 9 = Red Lamp Monitor group 2 - any lamp fail
- 10 = Red Lamp Monitor group 3 - first red fail
- 11 = Red Lamp Monitor group 3 - second red fail
- 12 = Red Lamp Monitor group 3 - any lamp fail

- 33 = Red Lamp Monitor group 4 - first red fail
- 34 = Red Lamp Monitor group 4 - second red fail
- 35 = Red Lamp Monitor group 4 - any lamp fail
- 36 = Red Lamp Monitor group 5 - first red fail
- 37 = Red Lamp Monitor group 5 - second red fail
- 38 = Red Lamp Monitor group 5 - any lamp fail
- 39 = Red Lamp Monitor group 6 - first red fail
- 40 = Red Lamp Monitor group 6 - second red fail
- 41 = Red Lamp Monitor group 6 - any lamp fail
- 42 = Red Lamp Monitor group 7 - first red fail
- 43 = Red Lamp Monitor group 7 - second red fail
- 44 = Red Lamp Monitor group 7 - any lamp fail

45 = Any lamp failure

46 = Any Red failure

Note: These bits are also set if the lamps are switched off at the controller. If dual controller monitoring is configured switching either controller lamps off will set these bits. If independent monitoring is required use separate group outputs allocated to each controller.

47* = Combined direct input or OTU fault present - used to provide a single reply bit for controller or OTU fault

48* = DFM failure indication

13 = OTU handset attached

14 = OTU Fault present in Log

15* = Count/Occupancy/Queue Unit 0 output

16* = Count/Occupancy/Queue Unit 1 output

17* = Count/Occupancy/Queue Unit 2 output

18* = Count/Occupancy/Queue Unit 3 output

19* = Count/Occupancy/Queue Unit 4 output

20* = Count/Occupancy/Queue Unit 5 output

21* = Scoot loop 0 output

22* = Scoot loop 1 output

23* = Scoot loop 2 output

24* = Scoot loop 3 output

25* = Scoot loop 4 output

26* = Scoot loop 5 output

27* = Scoot loop 6 output

28* = Scoot loop 7 output

29* = Scoot loop 8 output

30* = Scoot loop 9 output

31* = Scoot loop 10 output

32* = Scoot loop 11 output

49 = unit 0, HIOCC alarm bit,

50 = unit 1, HIOCC alarm bit,

51 = unit 2, HIOCC alarm bit,

52 = unit 3, HIOCC alarm bit,

53 = unit 4, HIOCC alarm bit,

54 = unit 5, HIOCC alarm bit,

55 = unit 6, HIOCC alarm bit,

56 = unit 7, HIOCC alarm bit.

57 = Serial data input

Note: 1) SCOOT loop allocations **MUST** be on either bit 0 or bit 4 of a reply byte. The following three bits are automatically reserved for SCOOT, overriding the previous configuration for these bits, hence giving a total of four reply bits per SCOOT loop.

2) Functions marked * are **NOT** available for use with the GOL command.

3) There will be a separate bit allocated for each loop monitored by HIOCC. There is a maximum of eight loops in total. Eight new reply bit functions have been allocated, as above.

3.3.3.14 OTU output bit source (GOL, KOL)

GOL {Output bit number: **0 - 15**} = { Output function: **0 - 255** } (0)

Comment: Defines the function of the OTU hardware outputs. The output function is as described for the GRL command above. (Except those marked *) The normal default is direct from the UTC control bytes.

3.3.3.15 Count/Occupancy/Queue unit input allocation/function (GIA)

GIA {Count/Occupancy/Queue unit no.:**0 to 5**} 0={Digital input no.:**0 to 31**} (0)

GIA {Count/Occupancy/Queue unit no.:**0 to 5**} 1={Unit function no.:**0 to 7**} (0)

Comment: The command has two index fields:

- 1) count/occupancy/queue unit number
 - 2) data selector - enter 0 or 1 as indicated below
- 0 to allocate the input line number for the unit
1 to allocate the unit function (see below)

Note: For N + 1 sites the input line allocation represents the kerbside lane loop. The remaining loops are connected consecutively to the next two or three inputs for two or three lane sites respectively. If required an additional unidirectional loop may be allocated to the innermost loop using the GUD command.

Function definitions for count/occupancy/queue configuration (GIA n 1 = x)

0 = Count/Occupancy/Queue unit not configured

1 = N count unit (single lane)

2 = 2 lane N + 1 count unit

3 = 3 lane N + 1 count unit

4 = N occupancy unit (single lane)

5 = 2 lane N + 1 occupancy unit

6 = 3 lane N + 1 occupancy unit

7 = Queue unit

3.3.3.16 Queue unit active time (Call time) (GAQ)

GAQ{Count/Occupancy/Queue unit no.:**0 to 5**} = {Queue active time.:**0 to 255**} (0)

Comment: To specify the time in seconds that a configured queue unit input must be active before its output becomes active.

3.3.3.17 Queue unit inactive time (Cancel time) (GIQ)

GIQ{Count/Occupancy/Queue unit no.:**0 to 5**}={Queue inactive time.:**0 to 255**} (0)

Comment: To specify the time in seconds that a configured queue unit input must be inactive before its output which was previously active is cleared.

3.3.3.18 Count weighting factor (GCF)

GCF{Count unit no.:**0 to 5**} = {Count weighting factor code.:**1 to 8**} (5)

Comment: The count weighting factor for each count unit is the number of internal counts required to cause the reply bit to change state. The data is selected using the table below. The value used depends on the maximum vehicle flow rate at each count site, generally a weighting factor of approximately twice the maximum flow will be required.

Data value	Count/Occupancy weighting factor
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128

3.3.3.19 Occupancy weighting factor (GOF)

GOF{Occupancy unit no.:**0 to 5**} = {Occupancy weighting factor.:**1 to 8**} (6)

Comment: The occupancy weighting factor is the number of internal counts required to cause the reply bit to change state. The value is selected using the table above (see GCF command). The internal count rate is 25 Hz for 100% occupancy so a weighting factor of 32 is normally used, giving a change of state every 1.28 seconds.

3.3.3.20 Input sense control (GIS)

GIS{Group of 8 inputs: **0 to 3**} = {Binary byte to indicate polarity of each Input, 1 = inverted (default 0), **see below**}

Comment: Enables any of the 32 buffered inputs to be inverted. This facility is required to cater for detectors with normally open output contacts.

The first field is set as follows:

- 0 - Inputs 0 to 7 (Port 0)
- 1 - Inputs 8 to 15 (Port 1)
- 2 - Inputs 16 to 23 (Port 2)
- 3 - Inputs 24 to 31 (Port 3)

The second field is a binary byte, each bit of which indicates the polarity of an input for the selected port. As an example, if inputs 9 and 12 need to be inverted the command is:

GIS1 = 00010010 where GIS1 indicates inputs 8 to 15 and 00010010 indicates the sense of these eight inputs as follows:

Input Number:	15	14	13	12	11	10	9	8
Input sense:	0	0	0	1	0	0	1	0 (1 = inverted)

3.3.3.21 Fault log entry reporting (GFA)

GFA{0 to 31} = {0 to 11111111} (11111111)

Comment: Used in conjunction with the OTU fault present reply bit function. The default configuration is that setting any bit of any fault flag will cause the OTU fault present status to be active. If a fault flag is not required to set the OTU fault present bit enter a data value of zero for the appropriate fault flag number. Special conditions apply to certain LMU faults, refer to LMU section for further information.

3.3.3.22 DFM stuck active time limit (GMA)

GMA (group select: **0-7**) = (active limit: **0-255**)

Comment: Used to set the required stuck active time limit for DFM for the selected group. The limit specifies the time in MINUTES unless 255 is entered when it is assumed that the inactive time limit should be used for both stuck active and inactive. The default values for all the active limits is 30 minutes.

3.3.3.23 DFM stuck inactive time limit (GMI)

GMI (group select: 0-7) = (inactive limit: 0-255)

Comment: Used to set the required stuck inactive time limit for DFM for the selected group. The limit specifies the time in HOURS unless 255 is entered when it is assumed that no stuck inactive monitoring is required. The default values for all the inactive limits is nine hours.

3.3.3.24 DFM time limit (GMG)

GMG {input byte select: 0-11} {input bit select: 0-7} = {group select: 0-7,255}

Comment: Used to select the DFM time limits set up by GMA and GMI for the input specified. The default value for all inputs is 255, which indicates that no DFM is required on those inputs. To start the monitoring of an input, use this command to allocate an input to a DFM group. Although any value above 7 disables monitoring, it is suggested that only 255 is used.

3.3.3.25 Lamp Test Facility (GLT)

GLT={Digital input no.: **0 to 31**} (255)

Comment: Setting this value to a valid input number (i.e. 0 to 31) provides a lamp test facility (for use with a green wave box). If the allocated input is active (i.e. "1") then all the OTU output relays are energised. The default value is 255 - lamp test facility disabled.

Notes.

The 32 inputs are numbered 1 to 32 in section 3.2.3.5, corresponding to the associated pin on the 40 way input connector, however the handset command numbers the inputs from 0 to 31, for the 32 inputs.

This facility is included in PB391 issue 2 firmware (and above).

Fault Flag and Data displays

3.3.3.26 Display Fault Log (GFS/KFS)

GFS (Fault Flag number : 0-31)

Comment: Displays Fault Flags and data as text. (This is available on PB392 issue 6 or later)

Refer to the following section (3.3.3.27) for more details of Fault Flags and their explanations.

3.3.3.27 Display Fault Flags (GLF)

GLF (Fault flag number : 0-31)

Comment: When the OTU detects a recognised fault the system error led is illuminated and an entry made in the fault log. The majority of the fault flags are set to 1 (i.e. bit 0 set) to indicate a fault, however flags 0,1 and 2 are a special case where each bit represents a lamp fault for a particular current sensor. Some fault flags have further information available in the fault data array that can be accessed using the GLD command.

Lamp Monitor Unit Fault Flags

Fault flag number (see GLD command)	Fault Description	Associated Fault Data
0	Lamp faults sensors 1 to 7	9 - 71
1	Lamp faults sensors 8 to 15	72 - 143
2	Lamp fault sensors 16 to 23	144 - 215
3	Controller dim/bright change failure	-
4	As 3 but for second lamp supply Comment: Indicates that no dim/bright changes have occurred in a 24 hour period	-
5	Too many dim/bright changeovers	
6	As 5 but for second lamp supply Comment: The allowed number of dim/bright changes has been exceeded in a 24 hour period	
7	Lamp monitor reset indication Comment: Warning that the lamp monitor has been reset by handset command.	-
8	Lamp monitor failure	216 - 220

Configuration Fault Flags

9	Configuration data for flashing aspects incorrect Comment: Not applicable to U.K. Lamp sequences
10	Configuration Data Fault Comment: Configuration data corrupted Reset OTU and re-enter data
11	Reserved

OTU error Fault Flags

12	Recoverable software error	221 - 226
----	----------------------------	-----------

13	Hardware fault	227
14	OTU battery switch off Comment: Configuration data will be lost Reset OTU and re-enter configuration data	-
15	DFM failure	228 - 239
16 [PB392]	Facility not available (The facility is not allowed on this board. See GAF/KAF and GPV/KPV commands)	-
17	Controller configuration changed Integral OTU only. See the Controller Handset Handbook information on the Integral OTU for more information.	-

3.3.3.28 Display Fault Data (GLD)

GLD (Fault data index : 0 - 227)

Comment: To examine fault data associated with certain fault flags

Fault data index 0 - 215 Lamp Fault Data (Fault flags 0 - 3 Lamp Faults)

If the KLP command is supported this information is also available using KLP.

The data for each current sensor is as follows:

Offset from starting index

0	-	Phase identification 0 = A, 1 = B etc
1	-	Number of current rises / Lamp failures - aspect pattern 0. Rises in high 4 bits - failures in low 4 bits
2	-	Rise/fail counts - aspect pattern 1
3	-	Rise/fail counts - aspect pattern 2
4	-	Rise/fail counts - aspect pattern 3
5	-	Rise/fail counts - aspect pattern 4
6	-	Rise/fail counts - aspect pattern 5
7	-	Rise/fail counts - aspect pattern 6

The data in the log is generally indicated against aspect pattern number as follows:

<u>Aspect Pattern No</u>	<u>Lamp Colour</u>
0	Red (R) or Red Man (Rm)
1	Green (G), Green Man (Gm), Wait (Wt) or Sign (S)
2	Amber (A)

- for Export lamp sequences the following pattern numbers are used:

1	Flashing Amber Ball (FL.B) (for XV2 type)
3	Flashing Amber (FL.A) (for XV3 type)

The following monitor types can record a fault in more than one aspect pattern number for failure of one colour. The aspect number where the failure is actually logged will depend on which aspects were showing at the time of the failure.

<u>Monitor type</u>	<u>Failed Colour</u>	<u>Pattern No.</u>
- UK Pelican and Intersection Ped. Including wait	Rm	0 if Wt off 2 if Wt on
	Wt	2
	Gm	1
UK Pelican and Intersection Ped. Stream	R	3
	A	1
	G	2
	Rm	1 if A on 2 if G on
	Wt	5 if A on 6 if G on
	Gm	3

Phase types 19 to 22 (Pedestrians with 40 Watt Waits) may report two lamp faults for only one lamp failure. Consequently these types will automatically clear all the faults when one lamp is replaced.

The following table gives the starting index value for the lamp fault data for each current sensor:

<u>Data Index</u>		<u>Data index</u>	
0	Sensor 0	108	Sensor 12
9	Sensor 1	117	Sensor 13
18	Sensor 2	126	Sensor 14
27	Sensor 3	135	Sensor 15
36	Sensor 4	144	Sensor 16
45	Sensor 5	153	Sensor 17
54	Sensor 6	162	Sensor 18
63	Sensor 7	171	Sensor 19
72	Sensor 8	180	Sensor 20
81	Sensor 9	189	Sensor 21
90	Sensor 10	198	Sensor 22
99	Sensor 11	207	Sensor 23

Fault data index 216 - 220 Lamp Monitor Failure Data (Fault flag 8)

- 216 Lamp monitor unit protected data corruption
- 217 Voltage monitor failure or ZXO failure - 1st lamp supply
- 218 Voltage monitor failure or ZXO failure - 2nd lamp supply
- Note: above fault data (index 217 and 218) is only provided if RED LAMP monitoring is configured
- 219 Mains state input failure - If a sensor monitoring a vehicle type has the second mains state input set to anything other than 255 it is assumed that it is the Red mains state input and it is expected that input will become active within a pre-set time after the mains state input goes active.
- 220 Reserved

Fault data index 221 - 226 Soft Error Codes (Fault flag 12)

Contains code numbers for the last three soft errors. The latest error is in data index 221 and 222. The first byte of each code is a data identity byte followed by a function identity byte. The function identity identifies the task or module that raised the error and the data identity identifies the specific cause for the error within that task (or module).

Firmware Scheduler (EDS) errors - Function Group 1:

- es list range error 1
- es sublist range error 2
- es free list empty 3
- es boost count restore error 4
- es boost count task error 5
- es 20ms task case error 6
- es 100ms task case error 7

es await 20ms/100ms tick error	8
es sp list empty error	9
es ready range error	a
es task range error	b
es aa event range error	c
es event range error	d
es image range error	e
es dummy load task case error	f
interrupt in-service stack overflow errors – ZXO	83
interrupt in-service stack overflow errors – tick	84
interrupt in-service stack overflow errors – peak	85
interrupt in-service stack overflow errors – UTC RX	86
interrupt in-service stack overflow errors – UTC TX	87
interrupt in-service stack overflow errors – handset	88
type 0 divide error	89
type 1 single step	8A
type 3 1-byte intl	8B
type 4 overflow	8C
type 5 array bounds	8D
type 6 undefined op-code	8E
type 7 ESC op-code	8F
any other unused vector	90
too many nested zxo timer interrupts	91
Handset Task errors - Function Group 2:	
handset task case out of range	1
handset config change failed	2
Shared RAM Task errors - Function Group 3:	
control shared RAM task case out of range	1
System Control Task errors - Function Group 4:	
system control task case out of range	1
invalid PLD facility code	2
PROM background check fail	3
Configuration Data errors - Function Group 5:	
config compatibility error	1
configuration task case out of range	2
config data validation failure	3
handset config update identity out of range	4
handset config update offset out of range	5
handset config update length out of range	6
handset config update access error	7
UTC Task errors - Function Group 6:	
UTC control and reply task case out of range	1
UTC control data not actioned	2
UTC loop function case out of range	3
protocol config data range error	4

Free Standing OTU interface task errors - Function Group 7:

free standing interface task case out of range	1
free standing interface task port verify error	2

LMU task errors - Function Group 8:

LMU task case out of range	1
LMU RLM data fault	2
RAM fault	3

Interrupt Function errors - Function Group 9:

local port verify error	1
ADC failure error	2

DFM Task error - Function Group A

DFM task case out of range	1
----------------------------	---

Fault data index 227 Hard Error Code (Fault flag 13)

Contains hard error code number:

- 0 - Unspecified error
- 1 - RAM enable error
- 2 - RAM Pattern test error
- 3 - RAM read/write error
- 4 - PROM error
- 5 - Too many Soft Errors

Fault data index 228 - 239 DFM failure data (Fault flag 15)

228 - port 0 DFM data (Bit 0 = input 0)

239 - port 11 DFM data

Each bit that is set indicates a failed detector input

Note: Only ports 0 to 3 apply to Freestanding OTU.

3.3.3.29 Display Lamp Faults with Phase information (KLP)

KLP displays the lamp fault data in KLD0 to KLD215 in a more user friendly format. This command is supported by PB392 firmware Issue 3 onward.

The response is in the format "P/cccccc +I -F"

Where - 'P' is the phase letter

'cccccc' is the phase colour

'+I' is the number of current increases (if any)

'-F' is the number of lamp failures (or 0 if none).

Example

```
Type 'KLP' <Enter> "A/Red      0" is displayed
Press the '+' key <Enter> "B/RedMan -1" 1st non-zero fault
Press the '+' key <Enter> "B/GrnMan +1 -0" 2nd non-zero fault
Press the '+' key <Enter> "P/Wait    +1 -0" 2nd non-zero fault
Press the '+' key <Enter> "KLP End of log  (no more faults)
```


Indexes can be used as follows:

KLP [<Sensor number: 1-23> [aspect ID: 0-6>]]

If no index is used the lowest value is used as default, hence, 'KLP' on its own is the same as 'KLP 1' and 'KLP 1 0'.

If a sensor is not configured (or configured as type '0'), or the aspect pattern requested is not used by the phase type, then KLP displays just the sensor number and aspect ID number followed by the number of faults, i.e.

"KLP S A: +I -F"

3.3.3.30 Reset Fault Log (RFL)

RFL = 1

Comment: Clears the OTU fault log and extinguishes the fault LED provided that fault conditions are no longer present.

LMU configuration commands

Note RED LAMP MONITORING on a Free standing OTU is not approved by the Department of Transport and should not be used.

3.3.3.31 Enable LMU data access (AMB) (NEC)

AMB = 35

NEC = 249

Some LMU configuration commands require these additional access commands to allow the data to be changed. Commands requiring this special access level are indicated by L after the command mnemonic.

3.3.3.32 Clear LMU Faults (KCF) - PB392 Firmware

KCF={Sensor Number:1 - 23}

Comment: This will clear all lamp faults associated for the specified sensor, e.g. "KCF=3" clears all faults on Sensor 3, KCF:0 will then be displayed.

Caution: The lamps on the junction should be inspected before using this command to ensure that no lamps are actually faulty.

Safety: This command will not clear a Red Lamp Fault on a sensor configured for Red Lamp Monitoring.

3.3.3.33 Aspect drive identification (KAD) L

KAD {sensor number: 1 - 23} = {aspect id. number 0 - 255}

Comment: This command is used to allocate an aspect drive identity to each current sensor.

For sensors monitoring a phase or wait indicator, the value entered defines the phase identity, i.e. 0=phase A, 1=phase B, 2=phase C etc.

For sensors monitoring a vehicle and a pedestrian phase together, the value entered defines the vehicle phase identity and the pedestrian phase is by default allocated the next phase identity, e.g. a value of 0 allocates the vehicle to phase A and by default the pedestrian is allocated phase B.

For sensors monitoring switched signs, the value entered defines the drive phase and colour:

0 = phase A, red drive
1 = phase B, red drive
etc

16 = phase A, amber drive
17 = phase B, amber drive
etc

32 = phase A, green drive
33 = phase B, green drive
etc.

For sensors which are unused or monitoring regulatory signs the value = 255.

3.3.3.34 Controller dim/bright changes expected (KDP)

KDP = { 0 or 1 } (1)

Comment: The default configuration assumes that the controller will perform dim/bright changeovers. If there is no change in a 24 hour period a dim change fault is indicated. For controllers with no dimming facility set KDP = 0 to disable this monitoring function.

3.3.3.35 Maximum allowable dim/bright changes (KDL)

KDL = (0 to 255) (63)

Comment: Maximum number of dim/bright changes in a 24 hour period that are allowed before a dim change fault is indicated.

Note: Setting KDP = 0 does not affect this monitoring.

3.3.3.36 Flashing Signals LMU disable input (KFD) L

KFD (0 - 1) = (0 - 255)

Comment: Some export controllers have a long term flashing mode that cannot be monitored by the LMU. During the flashing period the LMU can be disabled by allocating an input to inform the LMU that the signals are flashing. There are two possible input types that can be used:

KFD 0 = (input number: 0 - 31) (255 to disable).

This allocates a suitably configured controller output to the OTU input that goes active when the signals enter flashing mode.

KFD 1 = (input number: 0 - 31) (255 to disable).

This allocates a mains state input driven by the actual flashing supply.

Note 1. Only one of the above input types must be configured.

Note 2. The 32 inputs are numbered 1 to 32 in section 3.2.3.5, corresponding to the associated pin on the 40 way input connector, however the handset command numbers the inputs from 0 to 31, for the 32 inputs.

3.3.3.37 Mains states input configuration (KMS) L

KMS {mains state input: 0-2 } { sensor: 1 - 23 } = Input line number: {0 - 31} (255)

This item defines the digital inputs that provide the mains state(s) for the associated current sensor. Up to three input line numbers are required depending on the phase type being monitored (see table below).

The following is a list of the lamp mains state entries required for the different phase types that the current sensors can monitor. If no mains state is required enter the default value of 255.

Monitored Phase Type	1st entry	2nd entry	3rd entry
IV	GREEN	-	-
IVRLM	GREEN	RED	-
IP	GREEN	VEH. GREEN	-
PV	GREEN	PED. GREEN	-
PP	GREEN	-	-
PPW	GREEN	WAIT	-
PS	VEH. GREEN	PED. GREEN	WAIT
IPW	GREEN	VEH. GREEN	WAIT
IPS	VEH. GREEN	PED. GREEN	WAIT
XP1	RED	-	-
XV1	GREEN	-	-
XV2	BALL	-	-
XV3	GREEN	AMBER	-
W4	WAIT	-	-
W6	WAIT	-	-
RS	-	-	-
SB	SIGN	-	-
ST	SIGN	-	-

In addition, for PB392 Firmware:

PP4	GREEN	WAIT	-
PS4	VEH GREEN	PED GREEN	WAIT
IP4	PED GREEN	VEH GREEN	WAIT
IS4	VEH GREEN	PED GREEN	WAIT

Note The 32 inputs are numbered 1 to 32 in section 3.2.3.5, corresponding to the associated pin on the 40 way input connector, however the handset command numbers the inputs from 0 to 31, for the 32 inputs.

3.3.3.38 Phase type for current sensor (KPT) L

KPT {sensor number: 1 - 23} = {phase type no.: 0 - 255}

Comment: To specify the lamp or phase type for a current sensor as defined in the table below. See GLD command for further information on how lamp faults are reported.

Monitorable lamp/phase types	Type no.	Reported Fail Colours
Reserved	0	
Intersection Vehicle (IV)	1	R, A, G
Pelican Vehicle (PV)	2	R, A, G
Intersection Pedestrian (IP)	3	Rm, Gm
Pelican Pedestrian (PP)	4	Rm, Gm
Wait Indicator 40 Watt (W4)	5	Wt
Wait Indicator 60 Watt (W6)	6	Wt
Regulatory Sign (RS)	7	S
Switched Sign - Bulb type (SB)	8	S
Switched Sign - Tube type (ST)	9	S
Pelican Pedestrian + 60 W Wait (PPW)	10	Rm, Gm, Wt
Pelican Stream + 60 W Wait (PS)	11	R, A, G, Rm, Gm, Wt
Intersection Pedestrian + 60 W Wait (IPW)	12	Rm, Gm, Wt
Intersection Pedestrian Stream (IPS)	13	R, A, G, Rm, Gm, Wt
Reserved	14	
Export Pedestrian with flashing Red (XP1)	15	Rm, Gm
Export Vehicle with flashing Green (XV1)	16	R, A, G
Export Vehicle Filter - flashing Amber Ball (XV2)	17	Fl.B
Export Vehicle - flashing Amber signal group (XV3)	18	R, A, G, FL.A
Pelican Pedestrian + 40 W Wait (PP4)	19	Rm, Gm, Wt
Pelican Stream + 40 W Wait (PS4)	20	R, A, G, Rm, Gm, Wt
Intersection Pedestrian + 40 W (IP4)	21	Rm, Gm, Wt
Intersection Stream + 40 W Wait (IS4)	22	R, A, G, Rm, Gm, Wt
Sensor Unused - No type defined	255	

3.3.3.39 Mains States Input Sense (KIS) L

KIS{0 - 3} = {00000000 - 11111111} (0)

Comment: Enables the sense of the signals used to indicate lamp mains states to be inverted for any input line. This would be required if the controller provided closed contacts for active Green confirm outputs. Usage is similar to the GIS command.

3.3.3.40 Confirmation and Learn Count (KLC)

KLC={4 - 1500} (12)

Comment: To change number of readings required to confirm a failure or replacement, or learn a new characteristic.

3.3.3.41 Disable/enable Lamp Monitor (KLE)

KLE = 0 or 1

Comment: To enable or disable the Lamp Monitor facility (1 = enabled)

3.3.3.42 Lamp Monitor reset (KLR)

KLR = 1

Comment: Causes LMU to reset and relearn the lamp characteristics. This command must always be used before enabling the LMU for the first time.

3.3.3.43 OTU output bit source (KOL, GOL)

GOL {Output bit number: 0 - 15} = { Output function: 0 - 255 } (0)

Comment: Defines the function of the OTU hardware outputs. The output function is as described for the GRL command (see section 3.3.3.13 except those marked *). The normal default is direct from the UTC control bytes.

3.3.3.44 Red lamp monitor - 2nd failure disable (KRD)

KRD = 1

Comment: Used to temporarily remove the 2nd Red lamp failure output. This is required to restart part time controllers that shut down when two red failures occur.

3.3.3.45 Red lamp monitor - disable/enable (KRE) L

KRE {sensor number 1 - 23} = { 0 or 1 } (0), [(1) for pre PB392 issue 2.]

Comment: To select normal lamp monitoring (i.e. not red lamp monitoring) on vehicle phases set this value to 0 for each intersection vehicle sensor.

3.3.3.46 Red Lamp Monitor Group allocation (KRG) L

KRG {sensor number 1 - 23} = { 00000000 - 11111111 } (0)

Comment: Enables lamp faults associated with a particular sensor number to be allocated to one or more of eight monitor groups whose outputs provide the lamp fault signals to UTC and the controller. Setting bit 0 maps the sensor to group 0 etc.

3.3.3.47 Second Lamp Supply (KSS)

KSS = {sensor number 0 - 22} (0)

Comment: For dual controller applications defines the input number to be used for the second controller lamp supply voltage transformer.

3.3.3.48 Enable 50-0-50 V rms LMU Operation (KLV)

KLV=1 (0)

Comment: Set to 1 to enable LMU operation when a 50-0-50 V rms mains supply is being monitored. The default value is 0 for a 240 V rms mains supply. Note. This facility is included in PB391 issue 2 firmware (and above).

Diagnostic Display Commands

3.3.3.49 Display Control Data (GCD)

GCD (control byte number: 0 - 3) <enter>

Comment: Enables the control data currently being received from the instation to be displayed in binary format.

3.3.3.50 Display Digital Input Data (GDI)

GDI (input port number: 0 - 3) <enter>

Comment: Enables the state of the OTU digital inputs to be displayed in binary format.

Note: If this command is used to display the state of digital inputs which have voltage sensors attached, the value displayed will fluctuate between 0 and 1 for the particular inputs with voltage sensors attached, as the mains voltage waveform crosses the voltage sensor threshold during each mains cycle. Use the KDI command to display the value of the input at mains peaks only (see section 3.3.3.62).

3.3.3.51 Display Inputs use (GIU)

GIU (Input number 0-95)<enter> [PB392 issue 6 or later]

Displays what facility is assigned to each input, e.g. Reply 'S2' - indicates that the input has been assigned to Scoot unit 2. This command can be used to check the configuration of the inputs. For each input the command will display one or more of the following:

'U?a' or 'U?u'	Input is assigned to the A loop or the U loop of U/D unit ?.
'C?'	Input is assigned to Count Unit ?
'O?'	Input is assigned to Occupancy Unit ? {For N+1 count, or occupancy sites, the letters 'a' to 'd' are appended to identify up to four loops.}
'Q?'	Input is assigned to Queue Unit ?
'H?'	Input is assigned to HIOCC Unit ?
'S?'	Input is assigned to Scoot Unit ?
'L?'	Input is assigned as a Mains state for sensor ?

3.3.3.52 Display Firmware Identity and Issue state (GIC, KIC)

GIC<enter>

Comment: Displays Firmware Reference Number and Issue State.

3.3.3.53 Display PLD Variant (GPV, KPV)

GPV<enter>

Comment: Displays PLD Reference Number and Issue State.

3.3.3.54 Display Reply Data (GRD)

GRD (reply byte number: 0 - 14) <enter>

Comment: Enables the reply data currently being transmitted to the instation to be displayed in binary format.

Note: GRD 0 displays the first byte of the reply message that is the OTU address, MT bit etc. The first byte of reply data is accessed using GRD 1. The display is only valid for the configured number of reply bytes.

3.3.3.55 Display Lamp Monitor ADC readings (KAC)

KAC (sensor number: 1-23) (current/voltage selector: 0-1) <enter>

Comment: Displays the ADC current or voltage readings for configured Lamp Monitor sensors.

Note: The lamp monitor facility must be enabled for ADC readings to be available.

3.3.3.56 Display learnt load (KEL)

KEL (sensor number: 1 - 23)(aspect pattern number, 0-6):<enter>[PB392 issue 6 or later]

Comment: Displays the learnt loan in Watts at 240 V, with the associated phase and colour. If the load is not learnt, the display will indicate zero.

3.3.3.57 Display actual current (KES)

KES (sensor number: 1-23)<enter>

Comment: Displays the last current reading in milliamps on the Red or the associated phase and colour.

3.3.3.58 Display lamp supply voltage (KEV)

KEV (Lamp Supply: 0-1)<enter>

Comment: Displays the lamp supply in volts. If no second lamp supply is defined KEV will display 'KEV 1:N/A'.

3.3.3.59 Display LMU Aspect Learn Status (KAS)

KAS (sensor number: 1-23) (aspect pattern number: 0 - 6)<enter>

Comment: Displays a binary byte containing a set of flags (i.e. bits) indicating the status of LMU monitoring. There is one set of flags for each possible aspect pattern of each possible current sensor.

Note: Only those flags for valid aspect patterns of used sensors are generated, all others are set to zero.

The meaning of each bit is listed below:

Bit 0 - Awaiting_DIM - Aspect not yet appeared in DIM

Set if current dim/bright state is known to be bright and Awaiting_DIM_CHANGE is set. Cleared when dim/bright state is dim and Awaiting_DIM_CHANGE is clear

Bit 1 - Awaiting_BRIGHT - Aspect not yet appeared in BRIGHT

Set if current dim/bright state is known to be dim and Awaiting_DIM_CHANGE is set. Cleared when dim/bright state is bright and Awaiting_DIM_CHANGE is clear.

Note: Under certain conditions both Awaiting_DIM and Awaiting_BRIGHT bits can be set for an aspect. If this occurs neither bit will be cleared until the LMU has learnt the aspect in both dim and bright states.

Bit 2 - Awaiting_ASPECT - Aspect not yet appeared

Set on LMU initialisation. Cleared when aspect first learnt

Bit 3 - Awaiting_DIM_CHANGE - First dim/bright change assessment enabled

Set on LMU initialisation if dim/bright changeover monitoring is enabled. Cleared after first dim/bright change assessment for the aspect has been completed

Bit 4 - CONF_LOAD - Aspect being assessed for load change

Set when either the 'rise' or 'fall' load change counter is non-zero. Cleared when both the 'rise' and 'fall' change counters are zero.

Bit 5 - CONF_DIM - Aspect being assessed for dim/bright change

Set when either the 'dim' or 'bright' load change counter is non-zero. Cleared when both the 'dim' and 'bright' change counters are zero

Bits 6 and 7 - Not used

3.3.3.60 Display LMU Aspect Learn Status (KML)

KML<enter> [PB392 issue 6 or later]

Comment: Cycles round all the unlearnt phases and aspects indicating how complete the learning is as a percentage. If a Dim/Bright change is required the percentage will stop at 50%. When all the aspects are learnt in one state (Dim or Bright) and the LMU is waiting for the first Dim/Bright changeover, the KML indicates 'Awaiting D/B'. When the learning is complete, KML displays 'Complete'. If the LMU is not enabled (KLE:0), then the KML displays 'LMU Disabled'.

3.3.3.61 Display Controller Dim/Bright State (KDB)

KDB (lamp supply: 0 - 1) <enter>

Comment: Indicates the dim/bright state for each of the controller lamp supplies as shown below:

0 - state undefined (no change has occurred)

1 - dim

2 - bright

3.3.3.62 Display Mains State Inputs (KDI)

KDI (input port number: 0 - 3) <enter>

Comment: Enables the state of the LMU mains state inputs to be displayed in binary format.

The state of the input is only sampled at mains peaks so that the value displayed indicates whether the particular mains supply is on or off (because the voltage sensor output fluctuates depending on the point in the mains cycle, if the input was sampled at other times e.g. the zero cross over point, the display may indicate that the particular mains supply was off, erroneously).

3.3.3.63 Display Lamps ON/OFF State (KLM)

KLM (lamp supply: 0 - 1) <enter>

Comment: Indicates the state for each of the controller lamp supplies as shown below:

6 - lamps off

7 - lamps on

8 - change in progress (debounce period)

3.3.3.64 Display LMU Learn Status (KLS)

KLS <enter>

Comment: Displays the combined learn status bits for all aspects of all configured sensors. Refer to KAS command, bits 0 to 3, for the status bit definitions and layout. Only bits 0 to 3 are displayed, bits 4 to 7 are always 0.

3.3.3.65 Display Comms Message Log (GCT)

GCT (comms log code: 0 - 6)

Comment: Enables comms message and error counts to be displayed.

Note: To clear the comms log enter the command GCT 0 = 65535

Comms Log Code	Item
0	good messages
1	CRC errors
2	framing errors
3	sync errors
4	sync timing errors
5	sync byte corrupt errors
6	4 second time out errors
7	Upload / Download framing errors
8	Upload / Download block CRC errors
9	Upload / Download good blocks
10	Upload / Download good messages

Test / Maintenance Commands

3.3.3.66 Flow Counters (GCU)

GCU (Unit number: 0 - 5)

Comment: Enables the flow counters to be displayed.

Note: The counts are stored as words, so only the least significant byte is displayed.

3.3.3.67 Occupancy Counters (GOU)

GOU (Unit number: 0 - 5)

Comment: Enables the occupancy counters to be displayed.

Note: The counts are stored as words, so only the least significant byte is displayed.

3.3.3.68 Queue Signals (GQU)

GQU (Unit number: 0 - 5)

Comment: Enables the queue signal counters to be displayed.

3.3.3.69 Override Digital Inputs Enable/Disable (GIO)

GIO = 1 <enter>

Comment: Replaces the reply data with test data entered using the GID command - see below. The override can be disabled by entering GID = 0 and is also removed when the handset is disconnected.

3.3.3.70 Digital Inputs Override Data (GID)

GID (Reply byte number: 0-13) = (binary byte: 0 - 11111111)

Comment: Allows test data patterns for up to 13 reply bytes to be entered. The data is actually output when the override is enabled using the GIO command.

3.3.3.71 Override Digital Outputs Enable/Disable (GOO)

GOO = 1 <enter>

Comment: Replaces the control data with test data entered using the GOD and GTC commands - see below. The override can be disabled by entering GOO = 0 and is also removed when the handset is disconnected or after the 'GOT' timeout has expired (see below). With PB392 firmware (issue 4 or later) the GOO command displays GOO:2 whilst the override is active. If the special PLD is fitted (667/1/12399/106 - VMS + LMU) then the override is not removed when the handset is unplugged.

3.3.3.72 Override Digital Outputs Timeout (GOT)

GOT=(1-254 minutes, 255 disable timecount)

Comment: Displays the current timeout value, normally one minute. With a special PLD (667/1/12399/106 - VMS + LMU), the value can be changed. Without the special PLD, the value will always return one minute for reasons of safety.

Note The timeout facility is only present on PB392 issue 6 or later firmware.
{Issues 4 and 5 include GOT but the timeout is in seconds.}

3.3.3.73 Digital Outputs Override Data (GOD)

GOD (Control byte number: 0-2) = (binary byte: 0 - 11111111)

Comment: Allows test data patterns for up to three control bytes to be entered. The data is actually output when the override is enabled using the GOO command.

3.3.3.74 Transmit Confirm Override data (GTC)

GTC = (0 - 1)

Comment: In conjunction with the GOO command enables the state of the Transmit confirm LED output to be manually controlled.

3.3.3.75 Default Digital Outputs (GDO, GDT)

These commands define the default state of the outputs, i.e. the state to which the outputs default when the override is removed. Only available with special 667/1/12399/106 PLD.

3.3.3.76 OTU Reply Time (GTR)

GTR<enter>

Comment: Displays the time in milliseconds after receipt of the sync byte that the OTU will start its reply message.

High Occupancy Commands

Note that the HIOCC software is based upon a TRRL algorithm. For further details regarding operation and use of this algorithm see "TRRL Supplementary report 526, Automatic Incident Detection TRRL Algorithms HIOCC and PATREG".

3.3.3.77 High Occupancy Alarm threshold (GHA)

GHA {unit number: 0-7} = {percentage occupancy: 0-100} (100)

Comment: Occupancy alarm threshold (0 - 100%), is used to determine alarm conditions.

3.3.3.78 High Occupancy, timed zero occupancy (GHZ)

GHZ = {time in seconds: **0-255**} (8)

Comment: Zero occupancy will be assumed after the pre-set time.

3.3.3.79 High Occupancy, smoothed occupancy high value (GHV)

GHV = {percentage smoothed occupancy high level: **0-100**} (90)

Comment: Smoothed occupancy high value used for alarm detection.

3.3.3.80 High Occupancy, loop input allocation (GHL)

GHL = {Hi-Occ Unit: **0-7**} = {input bit: **0-31**} (255)

Comment: HIOCC loop input allocation, assigns an input bit (0-31) for each HIOCC unit (or 255 to indicate that the unit is not configured).

3.3.3.81 High Occupancy, number of consecutive samples (GHN)

GHN {loop no. **0 to 7**} = {**1 to 10**}. (3)

Comment: The number of consecutive occupancy samples used to determine if an alarm condition exists.

3.3.3.82 High Occupancy, smoothing factor (GHF)

GHF = {Smoothing factor: **0-100**} (2).

Comment: The smoothing factor used in calculating the new smoothed occupancy. This value represents actual smoothing factors of 0 to 1, i.e. the default value of 2 represents 0.02 for calculation purposes.

3.3.3.83 High Occupancy, clearance threshold (GHC)

GHC = {clearance threshold: **0 to 100**} (70).

Comment: The fixed clearance threshold is used to determine an alarm clearance condition in the event that the smoothed occupancy average is at an abnormal level prior to an alarm.

Remote Handset Commands

3.3.3.84 Open link to controller

XXC {Opens Link to Controller}

Comment: If the OTU is connected via a cable to the controller handset port, inputting **XXC** <CR> opens the link. Note that there will be a delay after initiating this command and the user should wait for about five seconds before attempting to enter controller handset commands.

3.3.3.85 Close link to controller

XXO {Returns Link to OTU}

Comment: Closes controller link and returns control to the OTU.

Engineering and Special Function Commands

The following commands are for engineering diagnostic use only and would not normally be required for maintenance operations. Refer to Siemens Engineering for further information.

3.3.3.86 Scheduler Dummy Routine Control (GDC, KDC)

3.3.3.87 Engineering Display Base (GEB, KEB)

3.3.3.88 Display Engineering data Items (GEG, KEG)

3.3.3.89 Display Engineering RAM data (GER, KER)

3.3.3.90 Display Processor Free Time (GFE, KFE)

3.3.3.91 Display Power-Up Data (GPU, KPU)

3.3.3.92 Run Time Monitor (GRT, KRT)

3.3.3.93 Display Soft Error Count (GSC, KSC)

OTU development test commands

The following commands are for OTU development test purposes only.

3.3.3.94 Message Count (Bit Error Test) (GMC)

3.3.3.95 Bit Error Count (GBE)

3.3.3.96 Modem Override (Test) (GMO)

3.3.4 Examples of Lamp Monitor Unit Configuration Using the Handset

NOTE. **RED LAMP MONITORING** on the Freestanding OTU is not approved by the Department of Transport and should not be used.

The LMU is configured via the handset and there are several example configurations detailed on the following pages. The main items of data to be entered and their associated handset commands are listed below:

- Define the type of output to be monitored by each current sensor (KPT)
- Specify the mains state inputs that are associated with each current sensor (KMS)
- Allocate an aspect drive identity to each current sensor (KAD)
- Select normal lamp monitoring (i.e. NOT Red Lamp Monitoring) for each vehicle phase (KRE)

Depending on the controller configuration, the following additional data may need to be entered:

- If the controller does not have dimming fitted, disable dim/bright checking (KDP)
- If the controller enters a flashing red/amber mode (export only), define the input to disable monitoring during the flashing period (KFD)
- Specify any inversions required on green state input signals (KIS)
- For dual controller monitoring, define the analogue input number to be used for the lamp supply voltage transformer on the second controller (KSS)
- Where the LMU is required to signal lamp fails to a separate OTU, define the output lines to be used (KOL)
- To monitor 50-0-50 lamps, select low voltage operation (KLV)

Example 1 - Simple 2 phase controller

Description: This is an intersection controller with two vehicle phases and lamp dimming.

The configuration commands are detailed below.

Enable LMU write access:

AMB = 35
NEC = 249

Allocate function of each current sensor:

KPT 1 = 1 :current sensor 1 monitors a vehicle phase
KPT 2 = 1 :current sensor 2 monitors a vehicle phase

Allocate mains state inputs for each current sensor:

Note: Input numbers 1 to 32 on the buffered input connector are referenced as 0 to 31 on the handset commands.

KMS 0 1 = 31 :mains state for sensor 1 is on
:digital input 32
KMS 0 2 = 30 :mains state for sensor 2 is on
:digital input 31

Allocate phase identity to each current sensor:

KAD 1 = 0 :sensor 1 is phase A
KAD 2 = 1 :sensor 2 is phase B

Select normal lamp monitoring (not RLM) on vehicle phases:

KRE 1 = 0 :sensor 1
KRE 2 = 0 :sensor 2

Reset the lamp monitor and enable lamp monitoring:

KLR = 1 :reset lamp characteristics
KLE = 1 :enable lamp monitoring

Example 2 - 4 phase controller with signs

Description: Four phase intersection controller with no lamp dimming. Two of the phases are vehicle and two are pedestrian. The controller also drives regulatory signs and two switched signs.

The wait indicators in this example are monitored using their own current sensors, separately from those used to monitor the pedestrian red and green (see example 3 for combined wait and pedestrian monitoring on one current sensor).

The configuration commands are detailed below.

Enable LMU write access:

AMB = 35
NEC = 249

Allocate function of current sensor 1 to 9:

KPT 1 = 1	:a vehicle phase
KPT 2 = 1	:a vehicle phase
KPT 3 = 3	:a pedestrian phase
KPT 4 = 3	:a pedestrian phase
KPT 5 = 5	:40 Watt wait indicators
KPT 6 = 5	:40 Watt wait indicators
KPT 7 = 8	:switched sign (bulb type)
KPT 8 = 9	:switched sign (tube type)
KPT 9 = 7	:regulatory sign

Allocate the mains state inputs associated with each current sensor:

Note: Input numbers 1 to 32 on the buffered input connector are referenced as 0 to 31 on the handset commands.

Note: No mains state required for regulatory sign.

KMS 0 1 = 31	:sensor 1 green is on digital input 32
KMS 0 2 = 30	:sensor 2 green is on digital input 31
KMS 0 3 = 29	:sensor 3 ped green is on digital input 30
KMS 1 3 = 31	:sensor 3 opposing vehicle green is on :digital input 32 (i.e. phase A green)
KMS 0 4 = 28	:sensor 4 ped green is on digital input 29
KMS 1 4 = 30	:sensor 4 opposing vehicle green is on :digital input 31 (i.e. phase B green)
KMS 0 5 = 27	:sensor 5 wait is on digital input 28
KMS 0 6 = 26	:sensor 6 wait is on digital input 27
KMS 0 7 = 25	:sensor 7 switched sign is on digital input 26
KMS 0 8 = 24	:sensor 8 switched sign is on digital input 25

Allocate aspect drive identity to each current sensor:

Note: No aspect drive required for regulatory sign.

KAD 1 = 0	:sensor 1 is phase A
KAD 2 = 1	:sensor 2 is phase B
KAD 3 = 2	:sensor 3 is phase C
KAD 4 = 3	:sensor 4 is phase D
KAD 5 = 2	:sensor 5 is phase C (wait)
KAD 6 = 3	:sensor 6 is phase D (wait)
KAD 7 = 4	:sensor 7 is phase E, red drive
KAD 8 = 20	:sensor 8 is phase E, amber drive

Select normal lamp monitoring (not RLM) on vehicle phases:

Note: Sensors 3 to 9 do not monitor vehicle phases and so they are configured for normal lamp monitoring by default - their configuration does not need to be changed.

KRE 1 = 0	:sensor 1
-----------	-----------

KRE 2 = 0 :sensor 2

Turn off dim/bright checks:

KDP = 0

Example 3 - 4 phase controller

Description: Four phase intersection controller with two vehicle and two pedestrian phases.

Each pedestrian phase is monitored with a single current sensor (see example 2 for separate wait and pedestrian monitoring using two current sensors per phase)

The configuration commands are detailed below.

Enable LMU write access:

AMB = 35

NEC = 249

Allocate function of current sensor 1 to 4:

KPT 1 = 1 :a vehicle phase

KPT 2 = 1 :a vehicle phase

KPT 3 = 12 :a pedestrian phase, including wait indicators

KPT 4 = 12 :a pedestrian phase, including wait indicators

Allocate the mains state inputs associated with each current sensor:

Note: Input numbers 1 to 32 on the buffered input connector are referenced as 0 to 31 on the handset commands.

KMS 0 1 = 31 :sensor 1 green is on digital input 32

KMS 0 2 = 30 :sensor 2 green is on digital input 31

KMS 0 3 = 29 :sensor 3 ped green is on digital input 30

KMS 1 3 = 31 :sensor 3 opposing vehicle green is on
digital input 32 (i.e. phase A green)

KMS 2 3 = 27 :sensor 3 wait is on digital input 28

KMS 0 4 = 28 :sensor 4 ped green is on digital input 29

KMS 1 4 = 30 :sensor 4 opposing vehicle green is on
digital input 31 (i.e. phase B green)

KMS 2 4 = 26 :sensor 4 wait is on digital input 27

Allocate aspect drive identity to each current sensor:

KAD 1 = 0 :sensor 1 is phase A

KAD 2 = 1 :sensor 2 is phase B

KAD 3 = 2 :sensor 3 is phase C
KAD 4 = 3 :sensor 4 is phase D

Select normal lamp monitoring (not RLM) on vehicle phases:

Note: Sensors 3 and 4 do not monitor vehicle phases and so their configuration does not need to be changed.

KRE 1 = 0 :sensor 1
KRE 2 = 0 :sensor 2

Example 4 - Pelican (single current sensor)

Description: This is a pelican controller with dimming.

In this example, the pelican is monitored with a single current sensor (see example 5 for separate wait and pedestrian and vehicle monitoring using three current sensors)

The configuration commands are detailed below.

Enable LMU write access:

AMB = 35
NEC = 249

Allocate function of current sensor 1:

KPT 1 = 11 :the current sensor monitors a complete
 :pelican stream

Allocate the mains state inputs associated with each current sensor:

Note: Input numbers 1 to 32 on the buffered input connector are referenced as 0 to 31 on the handset commands.

KMS 0 1 = 31 :sensor 1 vehicle green is on digital input 32
KMS 1 1 = 30 :sensor 1 pedestrian green is on digital input 31
KMS 2 1 = 29 :sensor 1 wait is on digital input 30

Allocate aspect drive identity to each current sensor:

KAD 1 = 0 :sensor 1, vehicle is phase A (and so
 by implication, the pedestrian is phase B)

Example 5 - Pelican (three current sensors)

Description: This is a pelican controller with dimming.

In this example, the pelican is monitored with three current sensors (see example 4 for combined wait, pedestrian and vehicle monitoring using a single current sensor).

The configuration commands are detailed below.

Enable LMU write access:

AMB = 35
NEC = 249

Allocate function of current sensors 1 to 3:

KPT 1 = 2 :pelican vehicle phase
KPT 2 = 4 :pelican pedestrian phase
KPT 3 = 6 :60 Watt wait indicators

Allocate the mains state inputs associated with each current sensor:

Note: Input numbers 1 to 32 on the buffered input connector are referenced as 0 to 31 on the handset commands.

KMS 0 1 = 31 :sensor 1 vehicle green is on digital input 32
KMS 1 1 = 29 :sensor 1 opposing pedestrian green is on digital input
30
KMS 0 2 = 30 :sensor 2 pedestrian green is on digital input 31
KMS 0 3 = 29 :sensor 3 wait is on digital input 30

Allocate aspect drive identity to each current sensor:

KAD 1 = 0 :sensor 1, vehicle is phase A
KAD 2 = 1 :sensor 2, pedestrian is phase B
KAD 3 = 1 :sensor 3, wait is phase B

Example 6 - 8 phase controller with phase overlaps, non fixed phases in stages

Description: Eight phase intersection controller with no lamp dimming. Six of the phases (A to F) are vehicle and one is pedestrian (H), Phase G is a Green arrow phase which only appears when demanded. Phase D appears in two stages which may run sequentially.

The wait indicators in this example are monitored using their own current sensors, separately from those used to monitor the pedestrian red and green (see example 3 for combined wait and pedestrian monitoring on one current sensor).

General: Refer to Figure 27, which shows the relationship between the OTU inputs, the OTU software modules and the OTU Reply bytes. For the phase to stage allocation see Figure 29.

Phase D green cannot be monitored using a standard UTC 'G' bit because it will stay at green when the phase appears in successive stages. It must be monitored using a voltage sensor. Other phases in the stage with phase D may still be monitored (i.e. Phase F) using 'G' bits, providing that they meet the normal requirements. Note that voltage sense transformers are normally assigned sequentially starting at digital input 31 and working back through 30 etc.

Phases G and H greens cannot be monitored using a standard UTC 'G' bit because they will not necessarily be at green in their respective stages. They must be monitored using a voltage sensor.

Green confirm bits may be used to report greens for phases A, B, C, E and F providing that leaving phase delays, or intergreens causing staggered phase introduction, are not used. If it is probable that phase delays and/or intergreens are going to be subject to on site changes in this way, it may be worth considering using voltage monitoring transformers on any phases likely to be changed.

The configuration commands are detailed below.

Enable LMU write access:

AMB = 35
NEC = 249

Allocate function of current sensor 1 to 9:

KPT 1 to 6 = 1 :vehicle phases A to F
KPT 7 = 1 :Green arrow phase is declared as a vehicle phase
KPT 8 = 3 :a pedestrian phase
KPT 9 = 5 :40 Watt wait indicators

Allocate the mains state inputs associated with each current sensor:

Note: Input numbers 1 to 32 on the buffered input connector are referenced as 0 to 31 on the handset commands.

KMS 0 1 = 31 :sensor 1 green (phase D) is on digital input 32.
KMS 0 2 = 30 :sensor 2 green (phase G) is on digital input 31.
KMS 0 3 = 29 :sensor 3 green (phase H) is on digital input 30.
KMS 0 4 = 28 :sensor 4 green (phase H Wait) is on digital input 29.
KMS 0 4 = 0 :UTC 'G1' bit green (phase A, B) is on digital input 1.
KMS 0 5 = 1 :UTC 'G2' bit green (phase F) is on digital input 2.
KMS 0 6 = 2 :UTC 'G3' bit green (phase C) is on digital input 3.
KMS 0 7 = 3 :UTC 'G4' bit green (phase E) is on digital input 4.
KMS 1 8 = 31 :A vehicle green which conflicts with phase H is chosen.
It is recommended that the most heavily trafficked phase passing through the pedestrian crossing point be chosen.

Allocate aspect drive identity to each current sensor:

NOTE: No aspect drive required for regulatory sign.

KAD 1 = 0	:sensor 1 is phase A
KAD 2 = 1	:sensor 2 is phase B
KAD 3 = 2	:sensor 3 is phase C
KAD 4 = 3	:sensor 4 is phase D
KAD 5 = 4	:sensor 5 is phase E
KAD 6 = 5	:sensor 6 is phase F
KAD 7 = 6	:sensor 7 is phase G
KAD 8 = 7	:sensor 8 is phase H
KAD 9 = 7	:sensor 9 is phase H, Wait drive

Select normal lamp monitoring (not RLM) on vehicle phases:

Note: Sensors 8 and 9 do not monitor vehicle phases and so they are configured for normal lamp monitoring by default - their configuration does not need to be changed.

KRE 1 = 0	:sensor 1
KRE 2 = 0	:sensor 2
KRE 3 = 0	:sensor 3
KRE 4 = 0	:sensor 4
KRE 5 = 0	:sensor 5
KRE 6 = 0	:sensor 6
KRE 7 = 0	:sensor 7

Turn off dim/bright checks:

KDP = 0

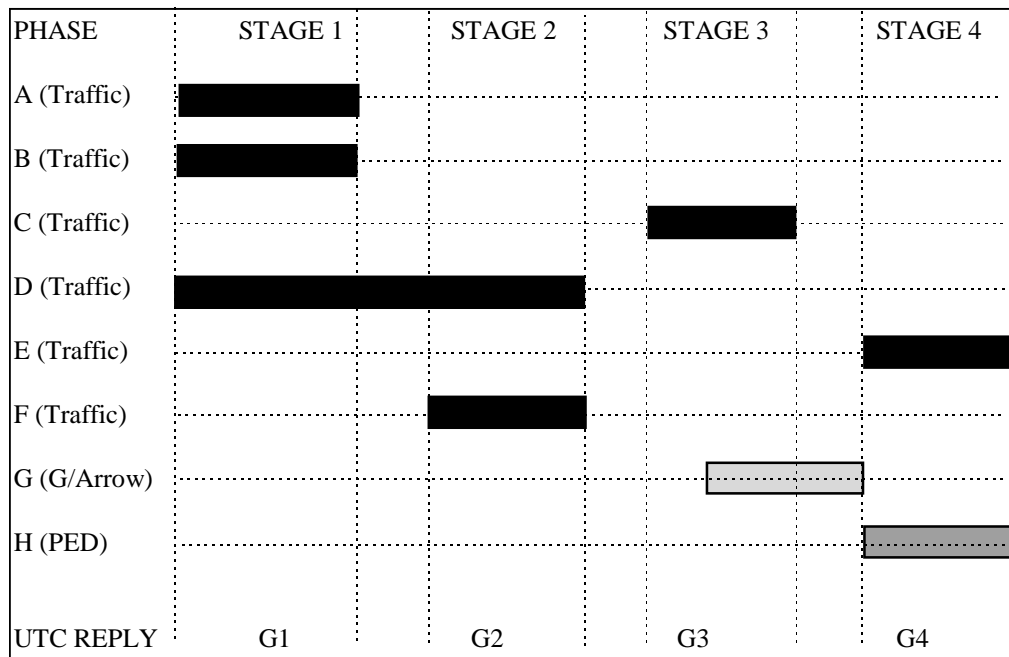
Reset lamp monitor

KLR = 1 :Resets LMU, and LMU relearns the lamp characteristics.

Enable lamp monitor facility

KLE = 1

Figure 29 - Phases in Stages for Example 6



Phases A to F are Vehicle phases of Type 0 appearance and termination.

Phase G is a Green Arrow of Type 2 appearance, terminating when E gains ROW

Phase H is a Pedestrian phase of Type 1 appearance.

3.3.4.1 LMU Commissioning

Note: **RED LAMP MONITORING** is not approved for use on the free-standing OTU by the Department of Transport and should not be used.

Once the LMU has been installed in the controller, the commissioning steps are as detailed below:

Enter the LMU configuration commands, if these have not already been loaded in (one option is to enter the configuration commands at the depot, prior to installation)

Reset the lamp monitor and enable lamp monitoring (KLR and KLE)

With the junction signals on, check that the voltage and current readings are as expected on each input (KAC)

Check that the mains states indicate on/off in line with the junction red, green and wait indicator displays (KDI)

Check that all lamps are working, including wait indicators

Allow the LMU to learn the lamps and check that learning is complete (KLS)

Note: If dimming is fitted to the controller, force the signals to dim and allow the LMU to learn the lamps in the dim state.

A more detailed description of junction learning and lamp failure checking is provided in the following sections.

3.3.4.2 Junction Self Learning during Commissioning

Force the controller to cycle round all the stages (e.g. by switching into fixed time mode) and initiate learning using the KLR and KLE commands.

To be sure that each controller output has been learnt, at least three complete cycles should be allowed. Note: Some controllers may have outputs (phases) which only appear under certain conditions. The commissioning engineer may decide to force these to appear (where possible) to ensure they are learnt before leaving the site.

Once an output has been learnt the LMU will commence monitoring automatically.

During the learning cycle the commissioning engineer should walk around the junction pressing any pedestrian push buttons that have wait indicators with them, and checking that there are no lamp failures already present on the junction. Any failed lamps should be replaced after the junction has been learnt.

Note: It is not necessary to invoke the self learning function again if a faulty lamp is found during the engineer's inspection of the junction, as the lamp monitor will automatically adjust to the new situation when the lamp is replaced.

The above sections describe the minimum requirements for installing an LMU. The following give details of extra procedures and tests to improve the reliability of, and confidence in the lamp monitor installation.

3.3.4.3 Learning the Other Dim/Bright State

The sequence above will have learnt the characteristics of the junction in one of the controller states (dim or bright). To completely learn the junction the controller should be switched to the other state, i.e. to dim if already in bright or vice-versa, and again three complete cycles of each controller output should be allowed.

The learning of the second state is automatic once the controller has been switched to that state and requires no manual intervention.

This means that it is not strictly necessary to manually switch the controller into the other state as the second learning sequence will be invoked automatically at the first dim/bright change, after the initial learning sequence was invoked.

It should be noted however, that lamp failures cannot be detected when the controller is in a particular state (dim or bright) unless the characteristics of the

junction have been learnt in that state. If the learning of the second state is left to occur automatically at the next dim/bright change, and the lamp failure occurs during or just after the change, it will not be detected by the LMU until the controller reverts back to the original state in which the junction learning was invoked.

3.3.4.4 Checking that Lamp Failures are Detected

The installation engineer may check that lamp failures are indicated when they occur and that lamp replacements remove the fault indication.

These checks should be carried out after the junction characteristics have been learnt.

Remove any lamp and wait for the LMU to find the failure. Indication that the lamp failure has been found will be given by the lighting of the system fail LED on the OTU PCB, and by the appropriate entry in the fault log. The installation engineer may check that fault information produced by the LMU is recognised by the equipment (OTU or controller) to which the fault outputs are connected if required.

Further lamps may be removed to check that lamp failures can be detected on other controller outputs.

3.3.5 TCSU TC12 OTU Commissioning Procedure

Reset OTU and select TCSU default configuration data.

Enter the following commands:

```
GME=249 (Access code)
LRN=53  }
CNN=117 } (Reset Codes)
TKE=191 }
```

Remove Mains power from the OTU, wait for a few seconds, then re-apply power.

Note: The value of 191 for TKE selects TCSU default configuration data but only when used to perform a complete OTU reset as detailed above.

To set up OTU address and enable communication.

Enter the following commands:

```
GME=249 (Access Code)
GAD=0 to 5 (OTU address - 6 OTUs on an Instation Modem)
GOE=1 (Enables Control and Reply)
```

Note

The read-only handset command GDD can be used to indicate the default configuration data loaded when the OTU was last initialised.

GDD = 0 Normal Default values

GDD = 1 TCSU Default values

The following table shows the TCSU default configuration values:

Table 7 - TCSU default configuration values

SUMMARY OF DEFAULT CONFIGURATION DATA CHANGES FOR TCSU TC12 OTU			
Handset Item	Standard	TCSU	TCSU Default Comments
GNO	1	6	Maximum number of OTUs per Instation modem.
GRW0 → GRW5 GSA0 → GSA11	4 No SCOOT loops allocated (255)	6 GSA0 = 16 GSA1 = 17 GSA2 = 18 GSA3 = 19 GSA4 = 20 GSA5 = 21 GSA6 = 22 GSA7 = 23	Number of Reply words for each OTU SCOOT LOOP- input allocation: 8 loops allocated to input port 2 - inputs 16 to 23.
GRL2 0 etc	From OTU input (0)	GRL2 0 =21 GRL2 4 =22 GRL3 0 =23 GRL3 4 =24 GRL4 0 =25 GRL4 4 =26 GRL5 0 =27 GRL5 4 =28	Reply bit function: Reply words 2, 3, 4, 5 allocated to 8 SCOOT nibbles. Reply words 0,1 default to OTU inputs to provide 16 traffic controller reply bits.

3.4 MAINTENANCE

3.4.1 Status LEDs

LEDs are provided on the front edge of the board to provide basic status information. The position of these LEDs and their functions are shown in Figure 30.

The +5 V LED should be on.

If the system fail LED is on, information about the type of fault that has occurred can be accessed using a handset terminal (see section 3.3.3.27 on handset commands).

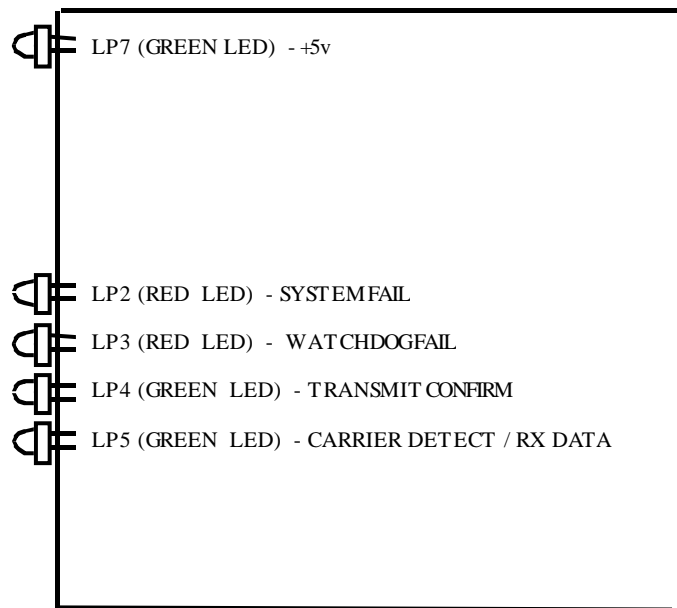
Note: the OTU may still be operating normally, even with the system fail LED on, depending on the type of failure that has been detected.

If the Watchdog fail LED is illuminated the software is not running correctly. All transmission from the OTU will be halted and all relay outputs will be set to their de-energised state. The only way to reset the board is to power off and then on again.

The Transmit confirm LED is on whilst correctly formatted control messages are being received by the OTU, and the information is being transferred to the relay outputs. If a valid control message is not received for four seconds the transmit confirm LED will go out. Note this LED does **NOT** indicate that a reply message has been sent.

The Carrier detect / Rx Data LED should come on once a second for each control signal on the line. For modem systems this LED indicates carrier is detected on the line. For RS232 systems where carrier is not required (see GRX command) the LED indicates data is being received. It does not indicate that the OTU received a valid control message.

Figure 30 - Outstation PCB Status LEDs



3.4.2 Effect of Incorrect Switch Settings on the OTU PCB

(1) S2 - Lithium Battery On/Off Switch

If this switch is off the system fail LED will illuminate on the OTU PCB the OTU will not communicate with the Instation.

(2) S3 - Line level switch

A 6-way DIL switch is used to set line levels. If switch positions 1 to 4 of the DIL switch are set incorrectly the OTU will transmit at the wrong output power.

WARNING - FOR UK USAGE THE OUTPUT POWER MUST NOT BE SET TO GREATER THAN -13 dBm.

If switch positions 5 and 6 are set incorrectly the receive threshold for the OTU modem will be wrong. If it is set too low corrupted control messages may occur. If set too high the control messages from the Instation may be undetected.

(3) SW4 - 2/4 Wire Select Switch

Four wire system but with two wire selected in error or two wire system but with four wire selected in error: the OTU will not receive the control signal and will not reply, therefore the carrier detect and transmit confirm LEDs will be OFF.

(4) S6 - 600 Ohm/High Impedance Switch

If the switch is set to high impedance when it should be set to 600 Ohms, the transmit signal for all OTUs on the line and the receive signal for the particular OTU will be up to 3dB higher than if the switch was set correctly. The characteristics of the line may also be affected.

If the switch is set to 600 Ohms when it should be set to high impedance this will reduce signal levels and may upset the characteristics of the line.

3.4.3 Fault Finding at the Outstation

Symptom

System Fault LED On

Watchdog LED On

OTU not replying to control message

OTU Inputs not working

Possible Reason

Use handset to access fault log for information on the type of fault that has occurred.

Software not running correctly. Switch off and on again.

OTU Switch settings incorrect
OTU configured incorrectly via the handset - repeat configuration.

NO power - Power led off, cable disconnected/fuse blown.

No control data - low line level, interference, BT lead disconnected or faulty.

Check fuse protecting 24 V rail

Symptom

No power to handset terminal

Possible Reason

Check handset fuse

3.4.4 Fuses

3.4.4.1 Outstation PCB Fuses

The outstation PCB is fitted with two fuses - FS1 and FS2; see Figure 18 for the position of the fuses.

Fuse FS1 is used to protect the +5 V supply for the handset terminal.

Fuse FS2 is used to protect the +24 V for the 32 Digital Inputs.

Both fuses are 500 mA 250 V Quick Blow 20x5 mm, part number 518/4/90285/004.

3.4.4.2 5 V Supply Fuse on the OTU Module Assembly

The 5 V signal from the PSU is fitted with a 5 A, 32 V, 1.25" Quick Blow fuse (part number 518/4/90286/007). This is situated on the side plate of the mechanics near the PSU and is labelled FS1.

3.4.4.3 Internal Power Supply Fuse

The Power supply (part number 667/7/22671/000) manufactured by XP PLC type NFS110-7602PK is fitted with a 5 A, 250 V fuse (518/4/90624/009). The power supply needs to be removed and the case taken off in order to change the fuse.

3.4.5 Lithium Battery

The outstation PCB is fitted with a Lithium Battery (B1, part number 418/4/97186/000), see Figure 18 for the position of the battery on the PCB.

This battery must be **replaced** every **four** years.

There may be a label already on the battery showing the date the battery was shipped. This should be covered with a label showing the **date the battery is fitted** into the equipment. The replacement date is therefore four years **after** the date on the label.

WARNING - Care should be taken when handling or disposing of Lithium batteries. Refer to code of practice CP526.

3.4.6 PSU

The power supply part number is 667/7/22671/000. To remove the power supply remove the OTU PCB, loosen the four screws inside the PCB bracket that hold the power supply in place. The power supply should now be pulled upwards until the

retaining screws line up with large holes in the slots for the screws. The power supply can be taken off by moving it sideways.

Power Supply Tests

If the power supply is suspected as being faulty, check the output voltage of the power supply on the Outstation.

Make sure the Outstation is powered down.

Disconnect the 13-way connector from the end of the power supply.

Power up the Outstation.

Check the +5 V output is between 4.75 V and 5.25 V (see Figure 31 for details of where to connect Multimeter).

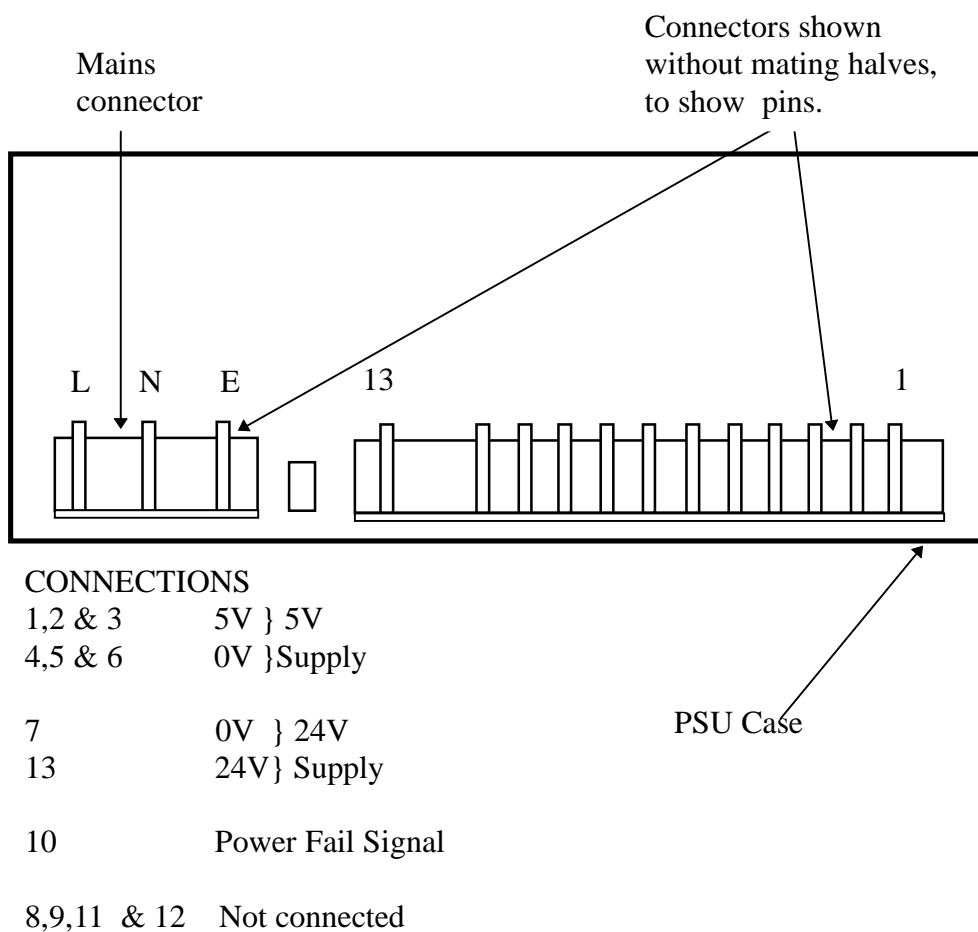
Check the +24 V output is between 22.8 V and 25.2 V (see Figure 31 for details of where to connect Multimeter).

Power down the Outstation.

Re-connect the 13-way connector to the power supply.

Figure 31 - Outstation PSU Voltage Checks

This diagram shows the end view of the Outstation Power Supply (Computer Products NFS110-7602PK)



3.4.7 Recommended Spares

The TC12 Family Tree part number is 667/DZ/22600/000. This shows the structure of part numbers within the TC12 system. The top level part number for the TC12 Freestanding OTU is 667/1/22670/000.

Outstation PCB Fuses FS1 and FS2 are 500mA 250 V
20x5 mm Quick Blow fuse 518/4/90285/004.

5 V Supply Fuse on the OTU Module Assembly:

The 5 V signal from the PSU is fitted with a
5 A 32 V 1.25"Quick Blow fuse 518/4/90286/007

Internal Power Supply Fuse 5 A, 250 V Quick Blow fuse 518/4/90624/009

Lithium battery 418/4/97186/000

Outstation PCB (Note swap IC23, PLD, from old 666/1/02239/001
board to new board when making
replacement)

OTU Power Supply 667/7/22671/000

OTU Input/Output Cable 667/1/22693/000

LMU Spares (if equipped):

Current Transformer 667/7/25171/000

Voltage Monitoring Transformer 667/7/25172/000

Voltage Sensor 667/1/22734/000

LMU cable Ferrite 905/4/10616/000

Optional spares:

Handset terminal 667/4/13296/000

4 TC12 INSTATION TEST SET

4.1 SPECIFICATION

4.1.1 Mains voltage and frequency ranges

The Instation test set will work over: 98 – 132 V RMS @ 47-63 Hz
198 – 264 V RMS @ 47-63 Hz

Note. The voltage range of the PC used in the Instation Test Set should be checked in the manufacturer's literature and note should be taken of any links/switches that need setting for different voltage ranges.

4.1.2 Mains Current

Instation test set 400 mA at 240 V

4.1.3 Size and Weight

Size:	
Height	530 mm
Width	354 mm
Depth	215 mm
Weight	13 Kg

4.2 INSTALLATION

4.2.1 Setting the Working Voltage Range Of the Instation Test Set

The power supply for the modem PCB and Instation Test Set Logic PCB is the same type as used on the Instation PSU PCB. Refer to section 2.2.4.1 for a description of how to set the voltage range of this power supply.

Note. The voltage range of the PC used in the Instation Test Set should be checked in the manufacturer's literature and note should be taken of any links/switches that need setting for different voltage ranges.

4.2.2 TC12 Instation Test Set Software Installation

The Instation Test Set software is installed by Engineering at Poole before the Test Set is shipped.

The software set up on the Instation Test Set PC should not be changed. If there are operational reasons for changing the software set up, the UTC Software Support Desk (01202 782440 or utcsupport@poole.siemens.co.uk) should be consulted before making any changes.

4.2.3 Error Messages during Test Set Software Start Up

During start up the test set software checks that it can access all the items that it needs. If any errors occur a message will be displayed which indicates the cause of the error.

If the test set cannot access either of the two necessary serial ports, an error message will be displayed in which the status number has the following significance:

Serial Port Errors

-2	Invalid Port	Contact engineering at Poole
-4	Invalid Buffer Size	Contact engineering at Poole
-5	No Memory	Contact engineering at Poole
-6	Port Not Set Up Correctly	Contact engineering at Poole
-3	Port Is Already In Use	Re-boot PC
-14	Port Required Could Not Be Found	Ensure machine is configured for two serial ports; COM1 and COM2

System faults

If the software fails to complete start up with the PC with error message "Internal Stack Overflow". This can indicate that the hardware connected to the parallel port is not powered correctly, i.e. the test set logic PCB.

Check that the mains switch on the test set is on and illuminated, indicating mains supply is reaching the test set.

Check that low voltage DC is present on the PCBs. Look at power monitor LEDs etc on test set modem PCB, by looking down at the rear of the PC where the LEDs are visible below the edge of the PC.

The power monitor LEDs on the modem PCB should indicate that power is reaching the logic PCB, as the modem PCB is powered via the logic PCB.

If power is ON switch PC off and then on again and start up the ITS software again. If it still fails contact engineering at Poole.

4.2.4 Terminal Emulation Software

As most TC12 Instations contains a PC which has no monitor the Instation test set PC may be used as the monitor to assist the installation commissioning and fault diagnosis of the Instation PC. To this end the test set is supplied with a copy of the CTERM program (an STC Terminal Emulator package).

4.2.5 Installation of Handset Software

A handset is used during installation, commissioning and testing of TC12 OTUs. It is used to configure the OTU, and when an OTU is installed in MCE0141 controllers a handset may also be used to interrogate the controller. It is recommended that the test set PC has a handset emulation package installed on it. To this end the test set may be supplied with the STC PITS (Portable Intelligent Terminal System) software.

4.3 OVERVIEW OF THE TC12 INSTANT TEST SET SETTINGS/SELECTIONS AND CONNECTIONS

4.3.1 Introduction

The TC12 Instant test set (part number 667/1/22702/000) is used to monitor and test the operation of the TC12 system. It can be used at all the TC12 baud rates and at any signal level between 0dBm and -63dBm. There is a pair of headphones that may be connected to the ITS to allow the user to listen to both control and reply messages.

There are three modes of operation for the ITS; Monitor mode, Instant mode, Outstation mode. Whichever mode the ITS is operating in, the physical connection to the unit under test does not change.

The Test Set can also be used as a handset for configuring OTUs and as a monitor for the Instant PC (for use during installation of the PC).

4.3.2 Connection to Unit Under Test

4.3.2.1 Control and Reply Test Jacks

The test set interfaces to the control and reply sockets on either a Modem PCB or OTU PCB. A cable is provided with a 15-way D-type at one end and two jack plugs at the other end. The D-type connects to the 'LINE INTERFACE' connector on the test set front panel. The jack plugs connect to the line jack sockets of the PCB under test. The control jack plug is marked with a white band. The reply jack plug is unmarked. The control sockets on the Modem and OTU PCBs have a white bar silk screened next to them to distinguish them from the reply socket.

4.3.2.2 Connection to the Modem PCB in the Instant

- (1) System with Modem PCBs connected direct to MDF

There are four modems on one Modem PCB. For each modem there is a control and reply jack socket. Modem 1 is connected to the top two sockets on the modem PCB, modem 2 to the next pair of sockets, etc. For each pair of sockets the top socket is the reply signal, and the bottom socket (with a white bar next to it) is the control signal.

- (2) Radial System with Modem PCBs and Transformer PCBs

Connection is made to the relevant modem PCB as described above. However each of the four modems on the modem PCB communicates with up to eight OTUs via the associated transformer PCB. Hence the signal at a control jack on the Modem PCB will be sent to up to eight OTUs simultaneously. The signal at a reply socket contains the reply from up to eight OTUs.

4.3.2.3 Connection to OTU PCB

There are two sockets on the front of the OTU PCB. The sockets are labelled on the silk screen. The top socket is reply and the bottom socket is control.

4.3.3 Front Panel Switches

4.3.3.1 Mains Switch

Mains switch and PC switch

Switching the Test Set off, using the rocker switch on the front panel, does NOT guarantee isolation from the mains.

4.3.3.2 Modem Mode Switch and Mode Set Switch

To select the transmission mode the following procedure should be followed;

Press and hold down the modem set button (before moving the modem mode select switch).

Whilst keeping the mode set button depressed, turn the modem mode switch to the appropriate setting.

Release the modem set button.

Note. If the modem set button is not depressed whilst the modem mode select switch is being moved, the test set may enter an unknown mode.

BELL Modes:

Switch Setting (Baud)	Full Description
1200 equ	Bell 202 with Equaliser Loopback
1200	Bell 202 Main Loopback
300	Bell 103

CCITT Modes:

Switch Setting (Baud)	Full Description
1200 equ	CCITT V.23 M2 with Equaliser Loopback
1200	CCITT V.23 M2 Main Loopback
600	CCITT V.23 M1
300	CCITT V.21

Note Selections at 300 Baud are Originate when the test set is in Instation mode and Answer when the test set is in Outstation mode, and a mixture when in monitor mode (i.e. test set modem 1 control in Answer mode, test set modem 2 reply in Originate mode). This requirement is an automatic selection made by the test logic board. The user simply has to select 300 baud and ITS mode.

4.3.3.3 Carrier Detect Level Switch

This switch selects the carrier detect sensitivity when:

The test set is in Instation mode and is receiving Reply messages from OTUs.

The test set is in Outstation Mode and is receiving Control messages from the Instation.

The test set is in Monitor mode and is receiving both Control and Reply

Turn the Carrier Detect Level Switch to the desired sensitivity, -33 dBm, -39 dBm or -42 dBm (these levels are equal to the carrier detect levels that can be set on the Modem PCB and OTU PCB). -39 dBm is the standard selection for use in the U.K.

4.3.3.4 Transmit Level Attenuation Switches

IMPORTANT NOTE - For UK Usage the Transmit Level of the Test Set should only be set between -13 dBm and -63 dBm. Under NO circumstances should the transmit level be set higher than -13 dBm, i.e. the attenuation switches should be set to at least 13 dBm (see below).

The test set front panel contains six transmit level attenuation switches. These switches select the transmit level when:

The test set is in Instation mode and is sending Control messages to OTUs.

The test set is in Outstation Mode and is sending Reply messages to the Instation.

The Maximum transmit Level is 0 dBm when all attenuation switches are in the OFF position. Setting the appropriate attenuation switch to ON, allows this 0 dBm level to be reduced by 1, 2, 4, 8, 16, 32dBm or any level between 0 dBm and -63 dBm by setting combinations of the attenuation switches to the ON position.

4.3.3.5 Test set/Handset Selection Switch

This switch allows the switching of the PC serial port 1 between the test set modem 1 (when it is being used in test set mode, where it is used for Control messages) and the 25 way D type "HANDSET" when the PC is to be used to communicate with other hardware via its serial port comm1, e.g. controller handset port when PC is acting as a handset.

When being used as a test set this should be in test set position.

IF the test set is to be used as a handset for an STC controller etc, using the STC PITS software also supplied with the test set. The switch should be set to handset and the appropriate cable connected from the test set HANDSET socket to the controller etc.

OR

IF it is to be used as a monitor for a TC12 Instation PC, using the STC CTERM software also supplied with the test set. The switch should be set to handset

and the appropriate cable connected from the test set HANDSET socket to the TC12 Instation PC serial port 1.

4.4 OVERVIEW OF TEST SET SOFTWARE SETTINGS/SELECTIONS AND OPERATION

4.4.1 Modes of Operation

4.4.1.1 Monitor Mode

Monitor mode allows control and reply messages to be monitored at either the Instation or at an OTU.

When the ITS is operating in this mode, the operation of any key (except the mode selection key) has no effect on the data being transmitted between the Instation and the OTU.

Connecting the ITS (in this mode) to the OTU or ITU does not cause an error in the data being transmitted between the Instation and the OTU for more than one second.

4.4.1.2 Instation Mode

In this mode the ITS replaces the computer and the Instation equipment. The ITS transmits at one second intervals to a selected OTU, a control message in accordance with the control data setup and displayed on the PC

4.4.1.3 Outstation Mode

In this mode the ITS replaces a selected OTU. The ITS displays any two characters of the control message being transmitted by the computer. In response to the control message the ITS transmits a reply message containing the data setup on the display.

4.4.2 Screens / Functions of the ITS

4.4.2.1 Manager

Under this menu option, the user can choose to recall or save the data entered for the current line configuration i.e. number of OTUs on the line, number of control and reply bytes for each OTU, optional OTU identifier strings for each OTU, baud rate, 2 or 4 wire and full or half duplex.

4.4.2.2 System Setup

Under this menu option the user can select screens to enter various items of data concerning the system and test set up.

4.4.2.2.1 ITS Modes

This allows the setting up of the mode of operation for the ITS.

MONITOR MODE monitors i.e. receives both control and reply messages from the line picking out the particular parts/messages associated with the selected/OTU under test. Whilst continuing to allow free communications between Instation and Outstations.

INSTATION MODE Simulates the Instation. In this mode the ITS isolates the line (if connected at Instation) or the OTU (if connected at the OTU) from the Instation and simulates the action of the Instation transmitting control data and receiving reply data.

OUTSTATION MODE Simulates an Outstation. In this mode the ITS isolates the line (if connected at Instation) or the OTU (if connected at the OTU) from the Instation and simulates the action of the an Outstation transmitting reply data and receiving control data.

4.4.2.2.2 OTU Info

On this screen all data pertaining to OTUs is entered i.e. Address/number of OTU selected/under test, line identifier string, OTU identifier string, number of OTUs on line and number of control and reply bytes for each OTU.

4.4.2.2.3 Transmission System

On this screen all data pertaining to transmission can be entered, plus a few miscellaneous items, i.e. 2 or 4 wire, baud rate, full or half duplex, which signal control/reply is to be measured for line level, where is ITS being used at Instation or at Outstation, and delay before transmit (normally 0 i.e. transmit at exact calculated time).

4.4.2.2.4 Data Entry/Testing

Once this screen has been entered testing is initiated. On this screen the state of each bit of control and reply data for the selected OTU is displayed for 3 control bytes and 14 reply bytes. When in Instation mode the control data can be changed, (using cursor keys to select the bit and space bar to toggle its state). When in Outstation mode the reply data can be changed, (using cursor keys to select the bit and space bar to toggle its state). When in Monitor mode no data can be changed the screen simply displays received data. The screen also indicates the status of CRCs received and to be transmitted, whether transmissions are occurring i.e. TX, whether carrier is being detected when receiving i.e. CD, what mode the ITS is in, what transmit mode is active i.e. transmit on tick or when prompted and if errors are being detected in received data i.e. Rx errors. There are also a number of special/quick keys that are effective when in this screen, to perform special actions.

USE F1 TO GET UP-TO-DATE HELP INFORMATION ON ALL SCREEN AND KEY FUNCTIONS.

4.5 USING THE TEST SET FOR FAULT FINDING ON TC12 SYSTEM

4.5.1 General

By connecting the test set into the TC12 system both at the Instation and Outstation and using the three modes available, it should be possible to isolate the item causing the problem i.e. the Instation, Outstation or the line between the two.

4.5.2 Starting up the Test Set

Ensure mains supply is suitable for ITS (see rating label), Connect to mains and switch on the mains at the test set (switch should illuminate).

IMPORTANT NOTE - For UK Usage make sure that the Transmit Level of the Test Set is set between -13 dBm and -63 dBm. Under NO circumstances should the transmit level be set higher than -13 dBm, i.e. the attenuation switches should be set to at least 13 dBm (see below).

Switch on PC

If PC auto boots into test set software, then after PC has done all of its own checks and loaded DOS the ITS software should auto load and the front screen should be displayed.

If PC does not auto boot then after the PC has done all of its own checks and loaded DOS and the C: prompt is displayed type in batch file name as follows ITS <CR>. The ITS software should load and the front screen should be displayed.

After successful loading of the ITS software the front screen will be replaced by a prompted indicating what baud rate the test set has been initialised to (taken from default.sav file which contains the set up of ITS as it was when last used). The user is prompted to ensure that the hardware (MODEMS) is set to the same baud rate.

After setting correct baud rate and confirming this by pressing any key, the user will be prompted for the location of the test set, AT INSTATION or AT OUTSTATION. This is important as this enables the correct loading factor to be employed to obtain accurate line levels.

After choosing the correct location and confirming by pressing ENTER, this prompt will be replaced by the main menu of the test set. Pressing F1 will obtain help on the menu system. Activating one of the sub menus then any of the choices in those sub menus and then pressing F1 will obtain help on that choice.

Before plugging the test set into the system the user must now configure the test set for the line to be tested.

4.5.2.1 Entering Information About the line and OTUs into the ITS

IF the information for the line has previously been entered and saved as an ITS DATA file this may now be recalled. Go to the "MANAGER" option, select

"RECALL" and enter relevant filename or choose from directory of "DATA" directory, and recall it (Press enter whilst on filename field).

ELSE Go to "SYSTEM SET UP" and select "OTU INFO". Now enter the number of OTUs on the line, and then for each of those OTUs enter its number of control and reply bytes in the appropriate fields. **OPTION** The line can be given an identifier string if required (9 alpha numeric characters) and this is simply entered in the "LINE REF" field. **OPTION** Each OTU may be given its own individual identifier string if required (9 alphanumeric characters). To do this select the OTU by entering the appropriate address in the "SELECTED OTU" field, and then move to the "OTU REF" field and enter the identifier. Repeat this for all OTUs as required. Now close this screen (press ESC) and select "TRANSMISSION SYSTEM". Now select on this screen the correct information for the line, i.e. 2 or 4 wire, baud rate and half or full duplex. **OPTION** This information can now be saved, from top menu select "MANAGER", then select "SAVE" enter relevant filename (8 characters which usually give a good indication of which line it is) or choose from directory of "DATA" directory (NB if it already exists in the directory the user will be prompted as to whether or not it is to be overwritten), and save it (Press enter whilst on filename field).

Now the Instation test set is ready for use.

Connect it in at the appropriate jack sockets at Instation or Outstation

Now enter the "DATA ENTRY / TESTING" screen and communications will commence.

Modes can be changed by going to the "ITS MODES" screen and selected OTU can be changed by going to "OTU INFO" screen. Quick keys are available for these actions to allow easy changing from the "DATA / ENTRY TESTING" screen.

4.5.3 Fault Diagnosis

4.5.3.1 Instation Test Set Error Log and Indicators

The test set keeps a log of all of the different types of errors it finds in the communications, and below is a list of the faults, (to see if there are any additional fault logs recently added to the ITS check HELP on the "DATA ENTRY/TESTING" screen). The fault log is displayed in a window at the right hand side of the screen and is switched on and off and cleared using special keys whilst in the "DATA ENTRY / TESTING". For keys see HELP on "DATA ENTRY / TESTING" screen.

BIC/BIR	Break in Control/Break in Reply message. Carrier unexpectedly went off before the complete Control/Reply message was received.
CFE/RFE	Control / Reply message framing error, i.e. missing stop bits.
CCRC/RCRC	Control / Reply message crc failures.
SL	First byte received when looking for start of the control message (after having previously been synchronised) was not a Sync byte. Either corrupted or simply wrong message.

IOR	Address of OTU in message received whilst expecting reply from OTU under test, was not address of OTU under test.
MTS	MT bit set in reply message received from OTU under test.
SCM/SRM	Short Control / Reply Message, i.e. insufficient bytes received.
CNL1/CNL2	Port1 / Port2 Carrier not low when expected. The Instation Test Set uses two comms ports to communicate with the system, it uses comms port 1 for all CONTROL communications, and comms port 2 for all REPLY communications. The ITS uses timings such that it starts checking for the start of a particular message during what should be the inter message gap prior to that message. Thus if when it starts checking for the message the carrier is still present and after a further short delay (see note below) it is still present, then it is adjudged to have missed the inter-message gap and indicates this error. NB 5 ms are allowed from start of checking before this error is flagged, in case it is simply a slight timing error which will then be flagged by the message started late error.
CMSL / RMSL	Control / Reply message started late. After the point at which the message should have started, the ITS opens a window (as does the Instation) during which it expects to receive the first byte of the message. If it does not receive the first byte the message is indicated as having started late.
RSE	Spare bit in reply message was in wrong state. Should always be 0
RTE	Type bits in reply message were in wrong state. They should always be zero for reply.

INDICATORS

IDLE	Indicator which will come up against each port if no data has been received for at least two consecutive seconds. Appears at left hand side of screen. (NB This is hidden by fault log when fault log is being displayed).
TX and CD	These two displays give an indication that communications are occurring.
RX Errors	This field generally indicates the last fault to be registered in the fault log. However one fault "Not Yet Synchronised" (which is displayed if data is being received but none of the data appears to be control data i.e. none of first characters in messages received are sync byte), may be displayed but there is no log for these.

4.5.3.2 Faults and their Indications

Below is a list of common faults and the possible indications with regard to the faults likely to be logged.

WHILST CHECKING AT INSTATION:

If **ONLY** any of the following faults are recorded when in Outstation or Monitor mode, Whilst OTUs respond with out faults to test set in Instation mode:

RTS (amber led) on Instation modem board not lighting

On test set, both Control and Reply Idle or only Control Idle, and/or CD indicator not showing carrier being detected.

POSSIBLE FAULT: **Instation not transmitting.**

If **ONLY** any of the following faults are recorded when in Instation or Monitor mode, Whilst UTC TCC/Instation see no faults with test set simulating the OTU, i.e. in Outstation mode:

CD (green led) on Instation modem board not lighting.

On test set **RFE, IOR, SRM, BIR, RSE, RTE, CNL2, RCRC, RMSL.**

POSSIBLE FAULT: Data corruption due to line or OTU, Now test at OTU. When tested at OTU If no faults recorded when simulating the Instation this would indicate that one of the other OTUs on the line might be interfering with the message. NB This can be checked from the Instation end if it is allowable to switch all other OTUs on the line off-line. Do this by going to the "TRANSMISSION SYSTEM" screen and selecting CRCs to all other OTUs except one under test to be incorrect. After approximately four messages with the incorrect CRCs all other OTUs will switch off line. If communications with OTU under test are now error free then one of other OTUs is interfering. NB OTUs will have logged the CRC errors and will need fault log(s) clearing if they are to remain accurate.

If **ONLY** any of the following faults are recorded when in Instation or Monitor mode, Whilst UTC TCC/Instation see no faults with test set simulating the OTU, i.e. in Outstation mode:

RMSL Reply not starting on time

BIR, RMS If OTU not replying with sufficient bytes

RCRC If OTU replying with too many reply bytes

POSSIBLE FAULT: **Minor incorrect timing / configuration in OTU. Now test at OTU.**

IF the test set is in Outstation mode and OTU faults are still being registered by UTC TCC/Instation and no OTU faults are recorded by the test set when simulating the Instation i.e. when in Instation mode, this indicates fault is with Instation, e.g. numbers of reply bytes for OTUs incorrect, baud rate incorrect, 2/4 wire selection incorrect or full/half duplex selection incorrect, for the line.

If **ONLY** any of the following faults are recorded when in Outstation or Monitor mode, Whilst OTUs respond with out faults to test set in Instation mode:

BIC, CMS If Instation not transmitting sufficient bytes and OTU is last on the line

RCRC If OTU replying with too many of to few control bytes

POSSIBLE FAULT: **Due to Control data errors e.g. incorrect numbers for OTU or incorrect numbers of OTUs on the line.**

If **ANY** of the following Recorded whilst in Outstation Or Monitor mode.

On test set, **CFE, CCRC, BIC, SCM, SL, Not Yet Synchronised.**

POSSIBLE FAULT: Data corruption due to incorrect baud rate at in station or faulty modem board.

WHILST CHECKING AT OUTSTATION:

If **ONLY** any of the following faults are recorded when in Instation or Monitor mode, Whilst UTC TCC/Instation operates with out OTU faults when test set is used to simulate the OTU, i.e. in Outstation mode:

On test set, Reply **Idle** and/or **CD indicator not showing carrier being detected.**

POSSIBLE FAULT: **Outstation not transmitting**, to confirm simulate OTU with test set, i.e. switch ITS to Outstation and check that UTC TCC/Instation is communicating with it. If the ITS is replying and Instation is not recording OTU faults. **Check OTU fault log** to determine reason for OTUs failure to reply.

If **ONLY** any of the following Recorded whilst in Outstation Or Monitor modes, Whilst OTU responds with out faults to test set in Instation mode.

On test set **CFE, CCRC, Not Yet Synchronised, BIC, SL.**

CNL1 Inter message gap between last reply message and start of next control message being infringed upon, check OTU replies especially OTU at last address.

POSSIBLE FAULT: Data corruption due to line or Instation. If already tested at Instation and no fault indicated by test set when this OTU is simulated with test set in Outstation mode, this would now indicate Line or Interference from another OTU on the line.

If **ONLY** any of the following Recorded whilst in Outstation Or Monitor modes, Whilst OTU responds with out faults to test set in Instation mode.

CMSL Control not starting on time more then one second between control messages.

BIC, CMS If Instation not transmitting sufficient bytes for this OTU if last OTU on line.

CCRC If Instation transmitting too many or too few control bytes for this OTU.

POSSIBLE FAULT: **Minor incorrect timing / configuration for this OTU at Instation.** If already tested at Instation and no control errors were recorded in Outstation or Monitor modes (test 6 and 7), then this would indicate a problem with the line.

If **ONLY** any of the following faults are recorded when in Instation or Monitor modes:

RMSL Reply not starting on time

BIR, RMS If OTU not replying with sufficient bytes

RCRC If OTU replying with too many reply bytes

CNL2 OTU replying too early.

POSSIBLE FAULT: **Minor incorrect timing / configuration in OTU.**

If any of the following faults are recorded when in Instation or Monitor mode:

CD (green led) on Instation modem board not lighting.

On test set the following errors occur

RFE, RCRC, IOR, SRM, BIR, RSE, RTE,

POSSIBLE FAULT: **Data corruption due OTU.** Check for baud rate incorrect, 2/4 wire selection incorrect or full/half duplex selection incorrect, for the line.

4.5.3.3 Fault finding - Where to start?

Firstly, it is best to determine from the errors recorded on the UTC TCC whether it appears to be a complete line that is faulty or individual OTU(s); i.e. some but not all OTUs experiencing faulty communications, and keep this in mind whilst testing. Then ensure that the test set is configured correctly for the line in question. Check the configuration against the UTC TCC database information for the line. If possible this information should have previously been validated in the test set as detailed in "Commissioning a line".

IF it is acceptable to take all the OTUs on the line OFF LINE set the test set in Outstation mode.

ELSE set it in monitor mode.

Connect the test set to the appropriate line test jacks on the modem boards in the TC12 Instation cabinet.

By checking each OTU in turn and checking the errors it should be possible to determine where the fault lies or what the next step to take is. If errors are detected in monitor mode it is best to obtain authority to take all OTUs on that line off line and re test in Outstation mode.

If the fault appears to lie with the OTUs in the field or the line, then testing at the OTU using the test will determine if it is the line, the OTU or other OTUs.

Connect the test set to the appropriate line test jacks on the OTU board.

By checking the OTU with the test set in Instation mode then any errors would indicate a problem with the OTU. Checking in Monitor mode any control error would indicate a possible problem with the line. Errors in the reply message for the OTU under test (when there were none during its testing with the ITS in Instation mode) would indicate interference from the line or other OTUs, check other OTUs starting with those either side of address of OTU under test.

4.5.3.4 Commissioning a Line

Configure the test set with the appropriate OTU and line details.

Connect the test set to the appropriate line test jacks on the modem boards in the TC12 Instation cabinet.

With the test set in Outstation mode check each OTU in turn simulate all OTUs on the line and repeat until all configuration faults are removed. You will have now ended up with a validated test set configuration for the line. The test set and this configuration can now be used to go round to each OTU in the field in turn and together with an Outstation test set and handset for the OTU, it will be possible to test all of the OTU interfaces prior to connection to the line.

4.6 USING THE TEST SET AS A MONITOR FOR THE INSTATION PC

Exit from any software currently being used on the test set PC. At the C: prompt, type TERM <CR>. This will activate the batch file TERM.BAT (which should be in the top level directory C:\ when copied from the ITS software master disk), which in turn will activate the STC terminal emulator CTERM.

Now switch Handset/Test Set switch to handset, then connect cable 667/7/15998/101 from the 25 way handset port on the test set, to the serial port on the Instation PC.

If using to assist fault diagnosis, take the Instation PC keyboard and Press H to get the help screens listing up (this should now appear on the test set PC screen) now choose help/diagnostic screens as required.

If using to provide a monitor for the PC whilst installing software/hardware into the TC12 Instation PC connect as above and then refer to installation process for TC12 Instation. Installation prompts and choices should be displayed on the test set PC screen when connected like this.

4.7 USING THE TEST SET AS HANDSET

Exit from any software currently being used on the test set PC. At the C: prompt, type TERM <CR>. This will activate the batch file LITEMNS.BAT (which should be in the top level directory C:\ after installation of PITS software), which in turn will activate the STC handset software.

The handset port on the equipment to which the handset is to be connected should be a 25 way D-type socket, connect it, to the handset port on the test set, using cable 667/7/15998/100.

Now the test set PC can be operated in "RS232 handset" mode as a handset for all equipment with handset ports to DTP specification MCE0141 / TR0141. Operate with reference to the PITS manual 667/HB/22406/000 and the appropriate handset handbook for the equipment for which it is being used as a handset.

NB The use of the "Intelligent facilities" i.e. Upload, Download, Guided mode and Intelligent handset mode is dependent upon the PITS software having built in specific details about the equipment for which it to act as a handset, and the PITS manual should be consulted to see if these intelligent facilities are applicable to the equipment.

4.8 MAINTENANCE OF INSTATION TEST SET

4.8.1 Recommended Spares

Switching the Test Set off, using the rocker switch on the front panel, does **NOT** guarantee isolation from the mains.

The mains plug must only be fitted with a 3 A or 5 A fuse.

Recommended spares: mains lead
test jack cable

Kit of cables, part number 667/1/22705/000

667/7/15998/100 Cable used when using test set as handset for controller etc
This is a 25 way male D-Type connector to 25 way male D-Type connector with two metres of cable with straight through connections with at least pins 1, 2, 3, 4, 5, 6, 7 and 20 connected.

667/7/15998/101 Cable used when using test set as a monitor for Instation PC
This is a 9 way female D-Type connector to 25 way male D-Type connector with two metres of cable with the following connections:

9 Way D type Socket	25 Way D type plug
2	2
3	3
4	6
5	7
6	20

4.8.2 Periodic Testing

Equipment must be regularly tested with a PAT (portable appliance tester).
Results must comply with the following limits OR with the values in the relevant clauses of the IEE wiring regulations in force at the time if they are more stringent.

Earth bonding impedance ≤ 0.1 Ohms (Testing Case, Front panel and panel on which PC sits).

Insulation impedance > 100 MOhms

Flash test impedance > 1 MOhms

Leakage during flash test < 3 ma

5 TC12 OUTSTATION TEST SET

5.1 SPECIFICATION

5.1.1 Mains voltage and frequency ranges

The Outstation test set will work over: 100/120/220/230/240 VAC
all +10%,-13%

Different internal connections are necessary for different voltage ranges.

The outstation test set will work over the frequency range 47 Hz - 63 Hz.

5.1.2 Mains Current

Outstation test set 100 mA at 240 V

5.1.3 Size and Weight

The test unit is housed within an Imhof Bedco equipment cabinet constructed of mild steel (Model 1280A) and having the following overall dimensions:

Size:

Height	191 mm
Width	330 mm
Depth	229 mm

Weight	6Kg
--------	-----

5.2 USING THE OUTSTATION TEST SET

The Outstation Test Set (part number 667/1/22657/000) is supplied with six cable forms (part number 667/1/22658/000 to /005). The Outstation Test Set is designed to simulate an OTU (OTU Mode) or traffic control equipment (Controller Mode) and is connected into the system via special test cables.

Note: THE SPECIAL TEST CABLES MUST ALWAYS BE USED WHEN CONNECTING THE OTS TO EITHER AN OTU OR TRAFFIC CONTROL EQUIPMENT

5.2.1 Facilities

All controls, connectors and indicators are mounted on the front panel.

5.2.1.1 Interconnections

Figure 29 shows the Outstation Test Set Front Panel. For operation in the OTU mode (i.e. to simulate an OTU) the front panel D-type **plugs** provide the connections to the traffic control equipment. For operation in the controller mode (i.e. to simulate traffic control equipment) the front panel D-type **sockets** provide the connections to the OTU.

Six OTS Test Cables are supplied for connecting to the equipment under test. Two pairs of D-type connectors mounted on the front panel provide for connections to either the OTU or the traffic control equipment. Figure 33 shows how to connect the Outstation Test Set to an OTU or controller.

Note that there are two cables in each case. The reason for this is that the test set has 16 switches to set outputs and 16 LEDs to display inputs, whereas the actual OTU has 16 outputs and 32 inputs. In controller mode cables 667/1/22658/000 and /001 when connected, both allow all 16 OTU outputs to be displayed on the LEDs. However the /000 variant of the cable also allows OTU inputs 1-16 to be controlled using the OTS switches, whereas the /001 variant of the cable allows OTU inputs 17-32 to be controlled.

In OTU mode cables 667/1/22658/000 and /001 when connected, both allow the setting of all 16 OTU outputs to be simulated using the OTS switches. These cables are connected using two pairs of adaptors, fitted at each end. The connection to the D-type plugs on the OTS is made using cables 667/1/22658/002 and 003 while the connection to the OTU input/output cable is made using cables 667/1/22658/004 and 005. These adaptors fit on the ends of the cableforms 667/1/22658/000 and 001, dependent on which one is being used. The /000 variant of the cable also allows OTU inputs 1-16 to be displayed on the OTS LEDs, whereas the /001 variant of the cable allows OTU inputs 17-32 to be displayed.

ON NO ACCOUNT SHOULD CONNECTIONS BE MADE TO BOTH OTU AND TRAFFIC CONTROL EQUIPMENT SIMULTANEOUSLY.

A CONNECTION FAULT indicator is lit if the test cable is incorrectly connected.
The mains lead is connected directly to the OTS.

Figure 32 - Outstation Test Set Front Panel

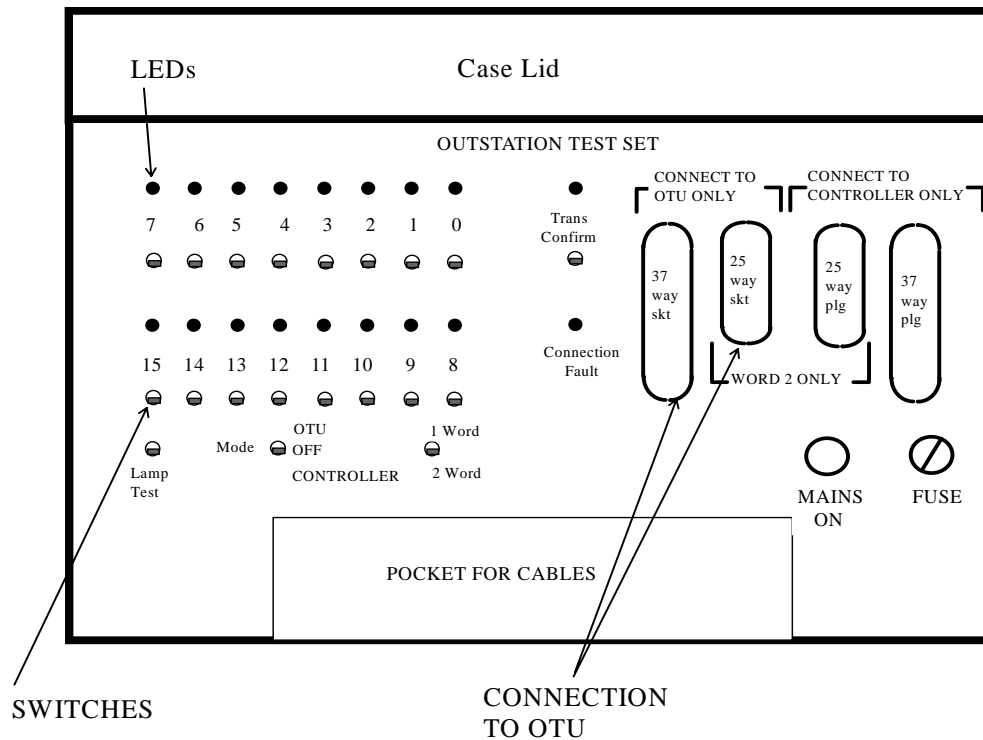
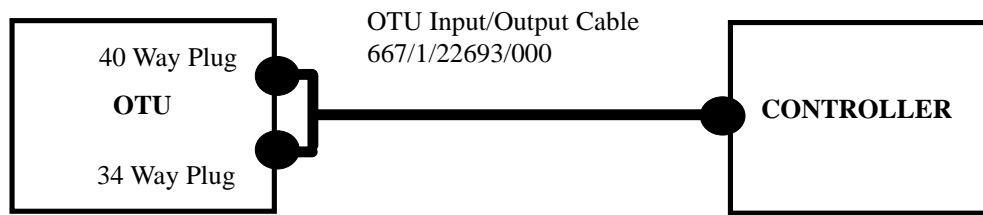
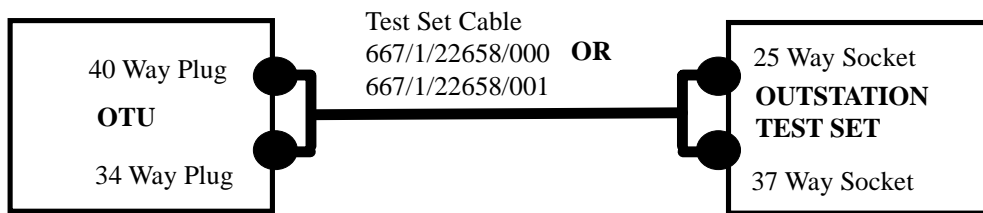


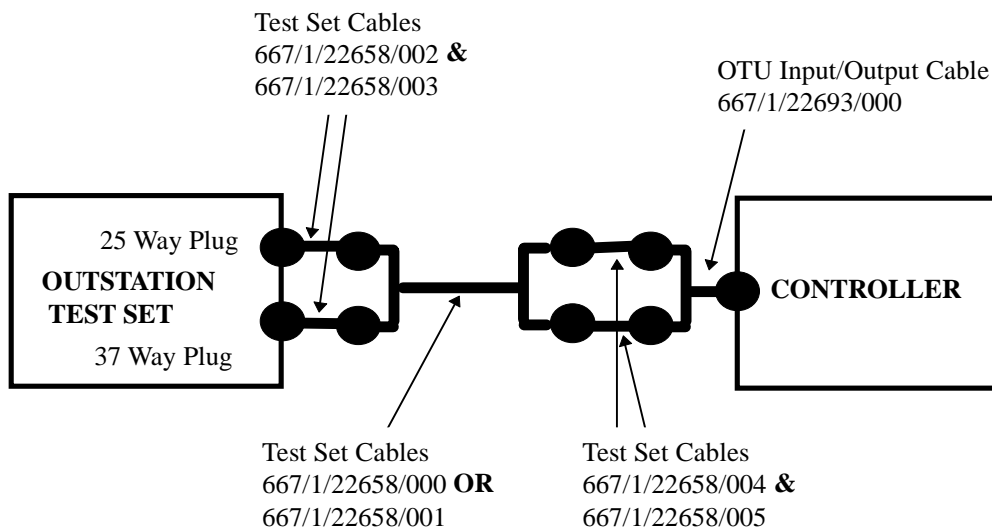
Figure 33 - Outstation Test Set Connections



a) Normal Equipment connection OTU to Controller



b) OTU to Outstation Test Set connection - Controller Mode



c) Outstation Test Set to Controller connection - OTU Mode

5.2.1.2 Controls

The following switch controls are provided:

- Word Selector : 1 or 2 words
- MODE Switch
- LAMP Test
- 16 Data Switches : Two 8-bit words
- Transmission Confirm : For intersection controllers to MCE0105 specification.

Switch operation:

Word Selector

If this switch is set to 1 word, only the 37 way plug (OTU mode) or 37 way socket (controller mode) can be attached. Only the first eight data switches then operate.

Generally this switch should be left in the 2 word position. Both the 37 way and 25 way plug (OTU mode) or 37 and 25 way socket (controller mode) must be connected up. All 16 data switches then function.

Mode Switch

Selects mode; OTU/OFF/CONTROLLER

Lamp Test

Checks all LEDs are working

Data Switches

Controller Mode	: Switch down = set reply bit (e.g. confirm stage)
OTU Mode	: Switch down = set control bit (e.g. force stage)

Transmission Confirm

For use in OTU Mode only, to confirm valid control message to MCE 0105 specifications.

5.2.1.3 Indicators

The following LED (Light Emitting Diode) indicators are provided:

A transmission confirm indicator active in the controller mode only.

A connection fault indicator which is lit if a mode is selected without the correct test lead connections, or conversely, if the correct test lead connections are made but the mode selection is incorrect.

16 data bit indicators for the two 8-bit words operating as follows:

CONTROLLER MODE LED ON = set reply bit (e.g. force stage)

OTU MODE LED ON = set control bit (e.g. confirm stage)

5.2.1.4 Connection Check Logic

The connection Check Logic circuit is incorporated within the OTS to ensure that:

- The correct test cable is used and is fully inserted into the D connectors.
- The word switch is selected appropriately to correspond with the requirements of the OTU/Controller.
- The mode switch is set to the respective simulation mode.

The above conditions are automatically checked when the appropriate plug/socket is inserted because the connectors incorporate links that activate the inputs to the Connection Check Logic.

If any condition proves faulty, operation of the rest of the circuit is inhibited and the Connection Fault LED is lit.

5.2.1.5 Mains Supply and Mains Voltage Range Selection

The mains supply is connected via a cable through the front panel of the OTS, which is wired for operation from a 240 V 50 Hz supply. A conventional 13 A plug with 2 A fuse is fitted to the power supply lead for connection to the mains. A neon lamp gives an indication of mains ON.

The outstation test set uses a Coutant Lambda HSB-1.7, 12 V 1.7 A power supply. This is supplied for use with a 240 V AC mains supply. It is possible to select any of the following mains supply voltages, 100/120/220/230/240 V AC +10%,-13%, all 47 Hz to 63 Hz.

To change the voltage range the power supply needs to be accessed. Remove four screws, two from the far right and two from the far left of the test set front panel. Lift out the front panel with attached electronics and power supply. Rest the front panel face down. The transformer of the Coutant Lambda power supply can now be seen. Follow the manufacturer's instructions for setting the different voltage ranges. The instructions are displayed on a label on the inside of the power supply side panel. Changing the voltage range involves moving the incoming mains connections to specified transformer taps and/or shorting together other transformer taps as specified.

5.3 OPERATION

5.3.1 General

Set the MODE and TRANSMISSION CONFIRM (TC) switches to the OFF positions. Connect the mains supply. Procedure is now according to the operating mode required.

5.3.2 OTU Mode (Simulating an Outstation)

5.3.2.1 Operation

Note. Using the OTS in OTU mode will affect transmission since the OTU input/output cable is detached from the OTU. This forces all OTU inputs to the "1" state and this will be transmitted to the Instation.

Connect the two D-type plugs on the test cable 667/1/22658/000 or /001 (depending on whether inputs 1 to 16 or 17 to 32 of the OTU wish to be monitored) to the D-type sockets on test cables 667/1/22658/002 and 003. Connect the test cables 667/1/22658/002 and 003 to the D-type plugs on the test unit marked 'connect to controller only'. The berg sockets on the test cable 667/1/22658/000 or 001 are connected to the test cables 667/1/22658/004 and 005. The test cables are then connected to the berg sockets on the end of the Outstation Input/Output cable (667/1/22693/000) which will be wired into the traffic control equipment.

Check LED operation by using the LAMP TEST switch. Set the word selection to 2 WORDS.

Set the MODE switch to the OTU position. (If the connection fault indicator is lit return the switch to OFF and check that correct plugs are fully inserted before proceeding).

Set up the required patterns for data Words 0 and 1 output to the traffic control equipment (Switches down to send control bit) - this simulates the 16 outputs on the OTU PCB.

Note. With both cable 667/1/22658/000 or /001 attached all 16 outputs are controlled.

Set the TRANSMISSION CONFIRM switch ON (DOWN position). The controller should respond to the data pattern set on the switches. The reply words from the controller are monitored on the data indicators - the indicators show what the status of 16 of the OTU inputs would be.

Note: Controllers manufactured to MCE106 are not fitted with a Transmission Confirm facility.

Repeat 5 as required allowing sufficient time for the controller to sequence according to the stipulated plan (approximately seven seconds).

Return MODE and TC switches to the OFF position.

Switching the TC switch OFF at any time simulates the word fail condition on the reed interface of the OTU, thus causing the traffic controller to revert to local operation independent of the test unit. Transmission Confirm does NOT indicate that the controller is under Computer control.

Notes: When changing the data switch settings during a test, operate the switch(es) for the new pattern before restoring the switches not required. If all switches are returned to '0' the Controller reverts to the free-running mode and will not respond immediately to any new instruction.

5.3.2.2 Using the OTS to Check the Wiring of OTU Inputs/Outputs

With the equipment set up as described above, the wiring of OTU Inputs/outputs to the controller via the Outstation Input/Output cable 667/1/22693/000 can be checked if a handset can be attached to the controller:

Checking OTU Output wiring:

Attach a handset to the controller and enter controller handset commands that display the status of the 16 controller inputs. Set different output bit patterns on the Outstation Test Set using the data switches. Ensure that the controller inputs displayed on the handset terminal are in the correct position and are the correct value.

Checking OTU Input wiring:

Attach a handset to the controller and enter controller handset commands to set the status of the 16 controller outputs. Set different output bit patterns on the controller handset terminal. Ensure that the OTU inputs displayed on the OTS LEDs are in the correct position and are the correct value.

5.3.3 Controller Mode (Simulating Traffic Control Equipment)

5.3.3.1 Operation

Note. Using the OTS in controller mode will affect transmission since the OTU inputs are set by the OTS switches, and these values will be sent to the Instation.

Connect the two D-type plugs on the test cable 667/1/22658/000 or /001 (depending on whether inputs 1 to 16 or 17 to 32 of the OTU, wish to be controlled) to the D-type sockets on the test unit marked 'connect to OTU only'.

Remove the 34 way and 40 way berg sockets from the OTU plugs and replace with the berg sockets of the test cable.

Check LED operation using the LAMP TEST switch. Set the word selector to 2 WORDS.

Set the Mode switch to the CONTROLLER position. (If the connection fault is lit return the switch to OFF and check that the plugs are fully inserted before proceeding).

Set up the required patterns for words 0 and 1 output to the desired 16 inputs of the OTU. The OTU responds to the data and transmits reply bits back to the Instation. The LED indicators on the OTS display the control data from the Instation. The transmission confirm indicator should be ON. (The transmission confirm switch is not used in this mode).

Repeat 5 as required.

If the transmission confirm indicator is not lit no data is transmitted from the OTU.

5.3.3.2 Using the OTS to Check the Functioning of OTU PCB Inputs/Outputs

With the equipment set up as described above the operation of OTU Inputs/Outputs can be checked:

Checking that OTU Outputs are working

Connect a handset to the OTU. Enter OTU handset commands to set the 16 OTU outputs. Check that the appropriate LEDs display the status of the outputs as set on the handset.

Checking that OTU Inputs are working

Enter OTU handset commands to display the status of the OTU inputs. Set different patterns on the OTS data switches and check that these are correctly displayed on the handset.

5.4 MAINTENANCE

A 1 A mains input fuse (part number 518/4/98042/001) is located within the front panel fuseholder. A 2 A fuse (part number 518/4/98009/004) within the chassis unit provides protection against certain types of traffic control equipment fault, e.g. a supply rail wrongly connected to the common signal return wire.

The mains plug is fused with a 2 A fuse (part number 518/4/98020/001)

The PSU (part number 605/4/97029/014) is a Coutant Power Pack (Model HSB12-1.7) rated at 12 V 1.7 A fully regulated. The unit supplies power to the two printed circuit boards (i.e. logic circuitry and relays) and LEDs.

6 INTEGRAL OUTSTATION TRANSMISSION UNIT (OTU/LMU)

6.1 GENERAL OVERVIEW

This section describes the Integral OTU/LMU. This is an additional PCB that can be used in the TC12 System. It can be fitted in T400 or ST800 traffic controllers or the ST700 pelican controller and used to communicate with a central office Instation Transmission Unit. In this respect the description of the relationship between OTUs and ITUs, given in the TC12 System Overview of section 1.6, is applicable. However there are a number of differences between the Integral OTU described in this section and the Freestanding OTU described in detail in Section 3. The main difference is that the Integral OTU can only be fitted in T400 and ST800 Traffic Controllers and the ST700 Pelican Controller. The Freestanding OTU on the other hand can be fitted to a variety of traffic controllers.

In more detail the differences between the Integral OTU and the Freestanding OTU are as follows:

The Integral OTU does not contain the two input/output connectors (used on the freestanding OTU to connect to the controller and/or detector cards), instead it contains a connector which is attached to the Extended System Bus Cable. All Information between the Controller and the Integral OTU is exchanged over this extended system bus.

The Integral OTU does not contain a separate handset port but is configured using a handset attached to the Controller.

The Integral OTU uses the UD facilities of the host controller. Handset commands such as CUD and UDT require maintenance level access as they are ST400/800 commands.

The Integral OTU can provide an LMU/RLM facility on the T400 only, and a connector allows current and voltage monitoring transformers to be attached for this purpose.

There is a pair of test jacks on the board to allow connection to the instation test set to monitor communications data and measure signal levels.

Note that except for physical board installation and LMU Voltage sensing the Integral OTU is the same as the Freestanding OTU. For message protocol and handset commands etc refer to earlier sections of the handbook. This Section details the differences between the Freestanding OTU and the Integral OTU.

See 667/1/25190/000 and 667/DZ/25190/000 for options available and family tree for this product. These are not included in this manual.

6.2 SPECIFICATION

6.2.1 Mains voltage and frequency ranges

The Integral OTU PCB is powered from the Controller power supply unit. The working voltage and frequency ranges are equal to those specified for the Controller.

6.2.2 Mains Current

Integral OTU

20 mA at 240 V

6.2.3 Temperature and Humidity Requirements

The OTU will work over the temperature range -15 to 75 °C.

Humidity

96% at 40 °C. non condensing

6.2.4 Size

Size: Double extended Euro card length PCB (220 mm) by 6U high (234 mm), with a maximum component height, off the board, of 19 mm (including cover and fixings).

6.3 INSTALLATION

6.3.1 General

Installation and commissioning of the Outstation is carried out in the following order:

- Configure the Outstation PCB via PCB switches
- Install PCB in Controller and Connect the cabling
- Configure the Outstation using the Handset terminal

The parameters that need configuring include:

Output power level. Warning - for use in the UK the power level must not be set to greater than -13 dBm.

Receive Threshold

2 or 4 wire line connection

600 Ohm or High Impedance line termination

Baud Rate/Mode

Outstation Address

Number of Outstations on the line

Number of control bytes for all Outstations on the line

Number of reply bytes for all Outstations on the line

Reply Bit Function

Fault Flag and Data Displays

LMU Information

(1), (2), (3) and (4) above are configured using switches on the Outstation PCB, as described below.

ALL others are configured using the handset terminal.

6.3.2 Configuring the Integral OTU PCB

Figure 31 shows a diagram of the Integral OTU PCB layout. The position of the switches, connectors and status LEDs are shown.

Ensure that the correct variant of the PCB has been supplied against the Works Specification, if this is available.

6.3.2.1 Safety Warning

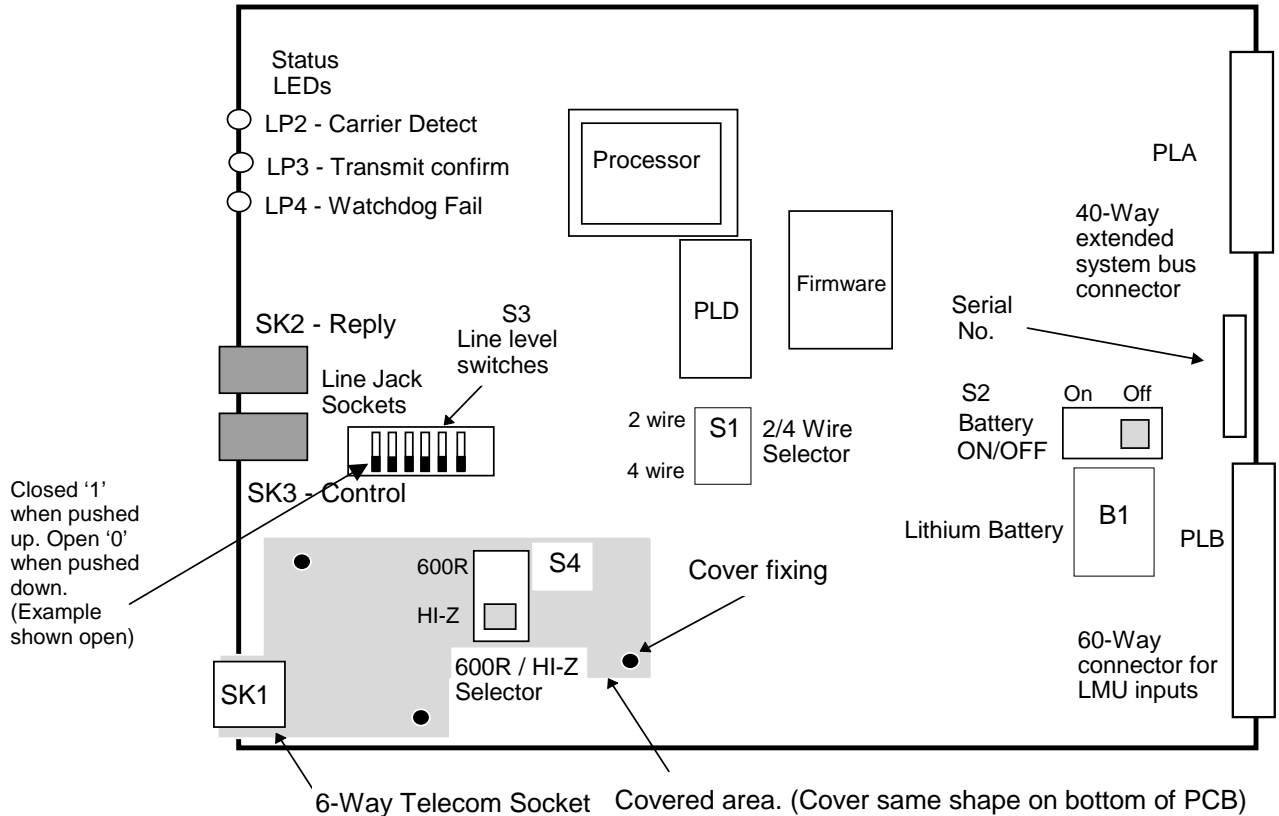
The TC12 Integral OTU PCB contains a lithium battery, B1 on Figure 34. Care must be taken with the use and disposal of this battery. The handling precautions in code of practice CP526 must be followed.

6.3.2.2 Cover

The PCB is fitted with a cover (part number 667/2/25192/000 front, 667/2/25193/000 rear).

The cover must ALWAYS be fitted before any cables are installed, and should NEVER be removed whilst the telephone cable (from socket SK1 on the PCB) is connected to the telephone network.

Figure 34 - Integral OTU PCB Layout and Switch Settings



6.3.2.3 Configuring the Switches on the Integral OTU PCB

Before any connectors are attached to the Integral OTU PCB, the configuration switches need to be set up as described below. Figure 34 shows the position of the switches on the PCB and the directions to set the switches to for different options.

There are four switches on the PCB:

S1	-	2/4 Wire Select Switch
S2	-	Lithium Battery On/Off Switch
S3	-	Line Level Switch
S4	-	600 Ohm/High Impedance Switch

These are set as follows:

1. S1 - 2/4 Wire Select Switch
Set to either 2 or 4 wire (see Figure 34) as required by the position indicated on the installation sheet for the Integral OTU.

2. S2 - Lithium Battery On/Off Switch
Set the Lithium Battery Switch (S2) to ON (see Figure 34).

3. S3 - Line Level Switch
Ensure that the Line Level switch (S3) is set to the required line levels. These are stated on the installation information sheet for the Integral OTU. Table 8 shows switch settings corresponding to the different levels. Switch S3 is a 6-way DIL switch. Switch positions 1 to 4 set the Output Power and switch positions 5 and 6 set the Receive Threshold. **Warning - for use in the UK the power level must not be set to greater than -13 dBm.**

4. S4 - 600 Ohm/High Impedance Switch
Switch S4 - Installation (To be performed by qualified/authorised installation/service engineer.)

WARNING - THIS SWITCH IS LOCATED UNDER THE PCB COVER. THE STC WARRANTY WILL BE INVALIDATED IF THE COVER IS LEFT OFF OR MISSING.

This switch is always set to the 600 Ohms position for all Radial, Multi Point and/or Multi Terminal lines. The switch is set to 600 Ohms during manufacture and therefore does not need to be changed. Where British Telecom or other telephone line supplier has agreed to provide Multi-drop circuits, i.e. where more than one OTU is to be connected to one line, **the final OTU on the line** is set to **600 Ohm**, all others on the line must be set to high impedance. Then the switch may be set as appropriate for the OTU, as noted below.

Note to Service / Installation engineers:

This switch is located underneath the cover. The top half of the cover should be removed in order to set the switch. No cabling should be connected at this stage, but before removing the cover make sure that the cable connected to socket SK1 of the PCB is not connected to the telephone network. Ensure the cover is re-fitted correctly after setting the switch.

Make a note of the switch setting on the OTU installation sheet for future reference.

5. The PCB can now be replaced back in the card guides.
Set the 600 Ohm / High Impedance line termination Switch (S4) to the setting indicated on the installation sheet for the Integral OTU (see Figure 34 for switch positions).

Table 8 - Integral OTU Line Level Switch (S3)

	Switch Number					
	← SW 1	SW 2	SW 3	SW 4	SW 5	→ SW 6
Output Power						
0 dBm	1	0	0	0		
-3 dBm	1	0	0	1		
-6 dBm	0	1	0	0		
-9 dBm	0	1	0	1		
-10 dBm	0	0	1	0		
-13 dBm	0	0	0	0		
-16 dBm	0	0	0	1		
Receive Threshold						
-42 dBm					0	0
-39 dBm					0	1
-33 dBm					1	0

0 = Switch Open
1 = Switch Closed

Warning - For use in the UK the power level must not be set to greater than -13 dBm. Only settings in the non-shaded area are allowed.

6.3.3 Connectors and Cables

6.3.3.1 Extended System Bus Ribbon Cable

Connect the Controller extended system bus cable to Plug PLA on the back of the Integral OTU PCB.

Note: Do not connect/disconnect the cable whilst the controller power is switched on.

Table 9 - Integral OTU PLA - 40 Way Connector

<u>PIN</u>	<u>NAME</u>
1	0 V
2	ADDRESS BIT 0
3	ADDRESS BIT 1
4	ADDRESS BIT 2
5	ADDRESS BIT 3
6	ADDRESS BIT 4

7	ADDRESS BIT 5
8	ADDRESS BIT 6
9	ADDRESS BIT 7
10	0 V
11	ADDRESS BIT 8
12	ADDRESS BIT 9
13	ADDRESS BIT 10
14	ADDRESS BIT 11
15	ADDRESS BIT 12
16	ADDRESS BIT 13
17	0 V
18	DATA BIT 0
19	DATA BIT 1
20	DATA BIT 2
21	DATA BIT 3
22	DATA BIT 4
23	DATA BIT 5
24	DATA BIT 6
25	DATA BIT 7
26	0 V
27	MEMORY WRITE
28	0 V
29	MEMORY READ
30	0 V
31	DATA TX / RX
32	DATA ENABLE
33	+5 V
34	WATCHDOG FAIL
35	POWER FAIL
36	RESET OUT
37	+5 V
38	ZERO CROSS-OVER
39	EXPANSION I/O PCB SELECT
40	+5 V

Table 10 - Integral OTU SK2 SK3 - Test Jacks

<u>PIN</u>	<u>Transmit Jack SK2 (REPLY)</u>	<u>Receive Jack SK3 (CONTROL)</u>
1	NC	NC
2	TC IN	RC IN
3	TC OUT	RC OUT
4	TC OUT	RC OUT
5	GND	GND
6	GND	GND

6.3.3.2 Telephone Cable with 6-way Plug

The OTU comes fitted with a telephone cable terminated in a 6 way telecom plug. Connect the telephone plug to the telephone socket in the traffic control equipment.

Note The cable should never be disconnected from the PCB Socket SK1 whilst the other end is connected to the telephone network (via the

network termination unit). In order to prevent the cable being disconnected from the PCB by accident the PCB cover fits around the end of the plug on the cable in order to retain it.

6.3.3.3 Connection of SCOOT Detector Inputs to an Integral TC12 OTU

On an integral TC12 OTU the SCOOT detector inputs to the controller should be connected to the normally open contacts on the detector backplane (make for vehicle presence). On an STC detector back plane these are the even numbered pins starting at pin 10.

6.3.3.4 Lamp Monitor Unit Connections

If the installation uses the lamp monitoring facility on the integral OTU card, then Current and voltage monitoring transformers are connected to PLB on the OTU PCB via a 64-way connector housing (part number 508/4/26138/008). The current and voltage monitor transformers have two wires each, terminated in crimps that push in to the connector housing.

Note: Only 60 positions are used on the 64 way housing. Positions 1, 2, 63 and 64 are unused as they do not line up with any of the 60 pins on the plug PLB.

Figure 33 shows the pin out of PLB. LMU input 1+ and LMU input 1- (PLB pins 1 and 2), correspond to positions 3 and 4 respectively on the 64 way housing and so on.

Figure 35 - LMU Input Connector

60 Way Connector to LMU Inputs					
PLB PIN	SIG NAME	BERG PIN	PLB PIN	SIG NAME	BERG PIN
1	LMU input 1 +	3 *	25	LMU input 13 +	27
2	LMU input 1 -	4	26	LMU input 13 -	28
3	LMU input 2 +	5	27	LMU input 14 +	29
4	LMU input 2 -	6	28	LMU input 14 -	30
5	LMU input 3 +	7	29	LMU input 15 +	31
6	LMU input 3 -	8	30	LMU input 15 -	32
7	LMU input 4 +	9	31	LMU input 16 +	33
8	LMU input 4 -	10	32	LMU input 16 -	34
9	LMU input 5 +	11	33	LMU input 17 +	35
10	LMU input 5 -	12	34	LMU input 17 -	36
11	LMU input 6 +	13	35	LMU input 18 +	37
12	LMU input 6 -	14	36	LMU input 18 -	38
13	LMU input 7 +	15	37	LMU input 19 +	39
14	LMU input 7 -	16	38	LMU input 19 -	40
15	LMU input 8 +	17	39	LMU input 20 +	41
16	LMU input 8 -	18	40	LMU input 20 -	42
17	LMU input 9 +	19	41	LMU input 21 +	43
18	LMU input 9 -	20	42	LMU input 21 -	44
19	LMU input 10 +	21	43	LMU input 22 +	45
20	LMU input 10 -	22	44	LMU input 22 -	46
21	LMU input 11 +	23	45	LMU input 23 +	47
22	LMU input 11 -	24	46	LMU input 23 -	48
23	LMU input 12 +	25	47	LMU input 24 +	49
24	LMU input 12 -	26	48	LMU input 24 -	50
			49 to 60	No Connection	

*** Important note:** The Berg connector is a 64 position header to allow correct mating with the 60 Way IDC connector. There are four unused positions on the Berg which have no associated mate on the IDC connector located on the PCB. Consequently, positions 1, 2, 63 and 64 on the Berg header have no connection to them. This corresponds to the top pair of holes and the bottom pair of holes.

Current Transformers

Each controller phase or illuminated indicator that is to be monitored requires one current sensor as detailed below. The table also indicates which lamp feeds are passed through the current sense transformer for each type.

Monitorable lamp/phase types	Current sensor lamp feeds	Maximum number of Signal Heads <u>(see note 1)</u>
Intersection Vehicle (IV)	Red, Amber, Green	16 { 6 }
Pelican Vehicle (PV)	Red, Amber, Green	16 { 6 }
Intersection Pedestrian (IP)	Red man, Green man	16 { 6 }
Pelican Pedestrian (PP)	Red man, Green man	16 { 6 }
Pelican Pedestrian (PP4)	Red man, Green man	16 { 6 }
Wait Indicator 40 Watt (W4)	Wait Indicator(s)	16 { 6 }
Wait Indicator 60 Watt (W6)	Wait Indicator(s)	16 { 6 }
Regulatory Sign (RS)	Sign	7 signs (21 tubes) {2 signs (6 tubes)}
Switched Sign - Bulb type (SB)	Sign	16 lamps {6 (note5)}
Switched Sign - Tube type (ST)	Sign	7 signs (21 tubes) {2 signs (6 tubes) note 4}
Pelican Pedestrian + Wait (PPW)	Red man, Green man, Wait Ind	16 (note 2) { 6 }
Pelican Stream (PS)	Red, Amber, Green, Red man, Green man, Wait Ind	16 (note 3) { 6 }
Pelican Stream (PS4) [40 W]	Wait Ind Red, Amber, Green, Red man, Green man, Wait Ind	16 (note 3) { 6 }
Intersection Pedestrian + Wait (IPW)	Red man, Green man, Wait Ind	16 (note 2) { 6 }
Intersection Pedestrian + Wait (IP4) [40 W]	Red man, Green man, Wait Ind	16 (note 2) { 6 }
Intersection Pedestrian Stream (IPS) [60 W]	Red, Amber, Green, Red man, Green man, Wait Ind	16 (note 3) { 6 }
Intersection Pedestrian Stream (IS4) [40 W]	Red, Amber, Green, Red man, Green man, Wait Ind	16 (note 2) { 6 }
Export Pedestrian with flashing Red (XP1)	Red man, Green man	16 { 6 }
Export Vehicle with flashing Green (XV1)	Red, Amber, Green	16 { 6 }
Export Vehicle Filter - flashing Amber Ball(XV2)	Flashing Ball	16 { 6 }
Export Vehicle - flashing Amber signal group(XV3)	Red, Amber, Green	16 { 6 }

Notes:

These limits apply to 240 V RMS supply voltage and 50 W lamp loads (unless stated). Where the supply is lower or the lamp loads are higher the limits are reduced accordingly. For example the figures given in curly brackets {} are the maximum loads when a 50-0-50 V RMS mains supply is used. The limits are only reduced if the actual voltage being monitored is at the lower level, i.e. if a 50-0-50 V RMS supply (derived from a transformer) is used but the monitoring is on the 240 V RMS side of the transformer, then the limits do not need to be reduced.

If the nominal load current (excluding red/ambers) of a particular controller output exceeds 4.0 A RMS, at nominal mains voltage, then that output should be split and treated as two separate outputs (although the same voltage sensor can be used for both).

For example, 8 pedestrian plus 8 wait indicator.

For example, 8 vehicle plus 4 pedestrian plus 4 wait indicator.

To allow monitoring of tube type signs at 50-0-50 V sites, the signs must be driven with the 50-0-50 V supply and the tubes must have the standard voltage-current characteristic.

CAUTION! The current sensors may produce a high voltage when not terminated into the OTU board if current is passed through the core.

The Current transformers (part number 667/7/25171/000) measure the current flowing in conductors that are passed through their core. To maintain the correct relationship between the current flowing in the conductors and the output from the sensor, the sensors must be connected the correct way round.

The current transformers are toroidal and one side is marked with a spot to indicate the input direction. The Live conductor(s) should pass from the controller output terminal(s) through the centre of the current transformer, entering the side with the spot marker, and on to the lamp(s).

The output wires from the current transformer are red (positive) and white (negative) and are terminated with Berg mini PV terminals which are clipped into a Berg mini latch housing to provide a complete sensor assembly which plugs into PL1 on the OTU board. Referring to Figure 35, the red wire connects to the required number LMU input shown with a +, and the white wire connects to the corresponding - input. Inputs should normally be allocated consecutively starting from number 1. The current sensors should then be anchored by passing a TYWRAP or equivalent through the sensor hole and around a suitable fixing point.

Up to 23 current transformers can be used per Outstation when equipped with LMU facilities.

Voltage Monitoring Transformer

A Voltage monitoring transformer (part number 667/7/25172/000) is used per Outstation when equipped with LMU facilities. The red and black wires connect to the lamp supply mains live and neutral being monitored (Red to Live and Black to Neutral). The orange and white output wires connect to PL1. Referring to Figure 35, the orange wire connects to pin 47 (LMU Input 24+ on PLB, i.e. pin 49 on the Berg mini latch) and the white wire connects to pin 48 (LMU Input 24- on PLB, i.e. pin 50 on the Berg mini latch).

The transformer should then be anchored to a suitable point in the cabinet.

Voltage Sensors

Voltage sense transformers (667/1/22734/000) are not required with the Integral OTU. Instead mains states are obtained from aspect drive information passed from the Controller Main Processor over the extended system bus.

6.3.4 Lamp Monitor Unit - Number of Current and Voltage Sensors

LMU Configuration

Before the detailed configuration of an installation takes place, it is often necessary to calculate the number of current sensors required. Tables to assist with this are given on the next page. To use these, fill in the appropriate information in the spaces provided and a final addition/subtraction of the values will give the number of sensors required.

Number of Current Sensors

Number of phases (include vehicle, green arrow and pedestrian phases)	+ ____
Number of pedestrian phases with wait indicators	+ ____
Number of switched sign drives	+ ____
Number of separately monitored regulatory sign drives	+ ____
Add one for each monitored load above 4 A RMS	+ ____
Subtract one for each wait indicator to be monitored by the same current sensor as the pedestrian phase	- ____
Subtract one for each pedestrian phase to be monitored by the same current sensor as the opposing vehicle phase	- ____
Total current sensors	= ____

6.4 COMMISSIONING

6.4.1 Commissioning Procedure after Power Up

1. Initialisation

The operator can initialise just the Integral OTU, just the Controller, or both together by using the appropriate handset command value:

Initialising OTU only:

Enter CNN=117, LRN=53 and TKE=199.

The Integral OTU is initialised as soon as the commands have been entered. There is no need to power off and then back on.

Initialising Controller only:

Enter CNN=117, LRN=53 and TKE=241.

Power off and then back on.

Initialising both the OTU and controller:

Enter CNN=117, LRN=53 and TKE=100.

Power off and then back on. Note: If the Integral OTU is not fitted or is disabled, the initialisation commands to the OTU will be ignored but the controller initialisation will continue unaffected.

2. OTU Override

The OTU fitted command OTF has level 3 access.

On a Pelican:

Enter OTF=1

To indicate that an Integral OTU is fitted.

Enter OTF=0

To indicate that an Integral OTU is not fitted.
(Default state.)

This change will have no effect until either,

- Only the OTU is reset (no power off/on) or

- Power is switched off and back on (whether resetting or not).

If the response is *C, this indicates that the configuration Prom does not support the Integral OTU.

If the response is *M, this indicates that the Firmware and configuration Proms do not support the Integral OTU.

On an Intersection Controller:

Enter OTF. The response will be OTF:1 if the Integral OTU has been configured as required in the configuration Prom. The response will be OTF:0 if the Integral OTU has been configured as not required in the configuration Prom.

Configure the Outstation using a handset terminal connected to the Controller Main Processor Board. See sections 6.3.2 and 6.3.4 for an explanation of commands that need to be entered.

Check that the status LEDs illuminate correctly, see section 6.5.1.

6.4.2 Configuration Using the Handset

With the Controller and OTU powered up, connect a handset terminal to the Controller Main Processor handset socket.

The Integral OTU is configured using a subset of the commands used to configure the Freestanding OTU. Commands that apply (see below) are entered in exactly the same way as for the Freestanding OTU as described in section 3.3.3.

Commands that apply to Integral OTU:

Section 3.3.3 Subsection No	Command		Section 3.3.3 Subsection No.	Command
1	GME, KME		49	GIU
3	GAD		50	GIC, KIC
4	GMM		51	GPV, KPV
5	GNO		52	GRD
6	GCW		53	KAC
7	GRW		54	KEL
8	GOE		55	KES
9	GSA		56	KEV
11	GRL		57	KAS
13	GIA		58	KML
14	GAQ		59	KDB
15	GIQ		60	KDI
16	GCF		61	KLM
17	GOF		62	KLS
19	GFA		63	GCT
24	GFS, KFS		67	GIO
25	GLF		68	GID
26	GLD		69	GOO
27	KLP		70	GOT
28	RFL ^{1 2}		71	GOD
29	AMB, NEC		72	GCT
30	KCF		73	GDO, GDT
31	KAD		74	GTR
32	KDP		84	GDC, KDC
33	KDL		85	GEB, KEB
34	KFD		86	GEG, KEG
35	KMS		87	GER, KER
36	KPT		88	GFE, KFE
38	KLC		89	GBE
39	KLE		90	GRT, KRT
40	KLR		91	GSC, KSC

¹ Note that the controller handset command RFL=1 clears the OTU and controller fault logs, and extinguishes the controller fault LED, if there are no longer any faults present.

² This command requires the PME command to be typed first.

Section 3.3.3 Subsection No	Command		Section 3.3.3 Subsection No.	Command
42	KRD		92	GMC
43	KRE		93	GBE
44	KRG		94	GMO
46	KLV			
47	GCD			
48	GDI ³			

The PC in the TC12 Instation Test Set can be used as a handset terminal -

Refer to section 4.6. The PC keyboard makes entry of commands easier than with a conventional handset terminal. Alternatively a conventional handheld handset terminal (the same type as used to configure controllers, part number 667/4/13296/000) can be used.

If the OTU is newly installed at the site or is a replacement unit it is necessary to perform a full OTU reset to clear any previous configuration data.

For full details of T400 Handset commands refer to 667/HH/20200/000, or for the ST800 Handset commands refer to 667/HH/27000/000.

6.4.2.1 OTU Handset command changes

The following OTU Handset commands are new or have been modified or extended for the Integral OTU:

ENO command: This allows the user to examine the OTU shared RAM. Range 0 to FFF.

OTS command: Integral OTU Soft error codes. For Engineering use only. (Read Only).

OTH command: Integral OTU Hard error codes. For Engineering use only. (Read Only).

OTO command: Define the function and output line number for the two special OTU/LMU outputs. Index 1. Range 0 to 1 for function. Index 2, Range 0 to 1 for output line. Index 3, Range 0 to 255. Default is 255 on all 4, i.e. no functions allocated, no output lines used.

OTO 0 0 = Function for first output, e.g. 100 gives any lamp failure in group 0.

OTO 0 1 = Output line for above function, e.g. 88 gives port 11 bit 0.

OTO 1 0 = Function for 2nd output, e.g. 101 gives first lamp failure in group 0.

OTO 1 1 = Output line for above function, e.g. 89 gives port 11 bit 1.

³ This command will give the same result as the controller command, IOP.

Functions available:

0	Control Bit 0 (Bit 0 of Word 0)
1	Control Bit 1 (Bit 1 of Word 0)
..
23	Control Bit 23 (Bit 7 of Word 2)
24 - 97	Not used
98	Any lamp failure in any group
99	Any Red Lamp failure in any group
100	Any lamp failure in group 0
101	1st Red Lamp failure in group 0
102	2nd Red Lamp failure in group 0
110	Any lamp failure in group 1
111	1st Red Lamp failure in group 1
112	2nd Red Lamp failure in group 1
..
170	Any lamp failure in group 7
171	1st Red Lamp failure in group 7
172	2nd Red Lamp failure in group 7
255	No function.

Note: Functions 103 - 109, 113 - 119 etc and 173 to 254 are not used.

6.4.2.2 Fault Flags/Data associated with Integral OTU

Fault Flag 58 - Fault with the Integral OTU and/or the facility (FLD 81)

Fault Data 81

This single fault data byte indicates the problem with the integral OTU facility or the integral OTU itself.

Bit 0: Automatically set when the integral OTU has any fault in its fault log, use the OTU commands 'GLF' and 'KLF' to examine the OTU fault log.

Bit 1: The Integral OTU has appeared to have failed or is not connected. RFL=1 will clear this fault if the OTU is now running, i.e. it failed for just a short time.

The following faults cannot be cleared by RFL=1 alone, most require the OTU facility to be reset by either:

Changing the value of the OTU fitted flag - OTF command,

The power is turned off and back on, or
The OTU is re-initialised using the three reset commands.

- Bit 2: The Integral OTU/LMU has appeared to have failed or is not connected and integral RLM is configured. This will switch the lamps off and not allow them back on even if the OTU/LMU has come back on line.
- Bit 3: The controller has detected an inconsistency in the lamp fault indications generated by the OTU. The OTU should detect such faults before the controller and put a fault in its own log.
- Bit 4: The shared RAM format used by the fitted OTU is not compatible with the firmware on the Controller.
- Bit 5: The integral OTU facility is enabled and an integral OTU has been detected but one is not supposed to be fitted.
- Bit 6: Configuration Fault: The integral OTU facility is enabled in the config PROM but the use of the second config area in the PROM (where the default OTU configuration resides) is not enabled.
- Bit 7: Not Used

6.4.2.3 Engineering Commands associated with Integral OTU

ENG 198 0 to 31

OTUCFLG - Integral OTUs current fault flags

The Integral OTUs Current Fault Log Flags - see OTU documentation.
Normal examination of the OTU's fault logs should be made using the OTU commands 'GLF' and 'GLD' rather than these engineering commands.

Note: This command can still be entered even if no Integral OTU is fitted or one is connected but has failed but will obviously not return the correct values.

ENG 199 0 to 255

OTUCDAT - Integral OTUs current fault data

The Integral OTUs Current Fault Log Data - see OTU documentation.
Normal examination of the OTU's fault logs should be made using the OTU commands 'GLF' and 'GLD' rather than these engineering commands.

Note: This command can still be entered even if no Integral OTU is fitted or one is connected but has failed but will obviously not return the correct values.

ENG 200 0 to 31

OTUHFLG - Integral OTUs historic fault flags

The Integral OTUs Historic Fault Log Flags - see OTU documentation.
Normal examination of the OTU's fault logs should be made using the OTU commands 'GLF' and 'GLD' rather than these engineering commands.

Note: This command can still be entered even if no Integral OTU is fitted or one is connected but has failed but will obviously not return the correct values.

ENG 201 0 to 255

OTUHDAT - Integral OTUs historic fault data

The Integral OTUs Historic Fault Log Data - see OTU documentation.
Normal examination of the OTU's fault logs should be made using the OTU commands 'GLF' and 'GLD' rather than these engineering commands.

Note: This command can still be entered even if no Integral OTU is fitted or one is connected but has failed but will obviously not return the correct values.

ENG 202 0 to 21

OTULMUF - Integral OTUs lamp fault indications

ENG 202 0	Not Used
ENG 202 1	Lamp faults on RLM group 0 (see below for format)
ENG 202 2	Lamp faults on RLM group 1
...
...
ENG 202 8	Lamp faults on RLM group 7
ENG 202 9	Any red lamp failure (if 1)
ENG 202 10	Any lamp failure (if 1)
ENG 202 11-21	Binary inverse of the previous 11.

Lamp faults format:

X	X	X	X	X	LF1	RL2	RL1
---	---	---	---	---	-----	-----	-----

X - Not Used

RL1 - 1st Red Lamp failure within this group

RL2 - 2nd Red Lamp failure within this group

LF1 - Any lamp failure within this group

Note: This command can still be entered even if no Integral OTU is fitted or one is connected but has failed but will obviously not return the correct values.

ENG 203 - 210 0 to 255

OTUSRx - Integral OTUs shared RAM sections 0-7

These eight codes can be used to display any byte within the shared RAM interface between the Integral OTU and the controller. For ease of use, it is recommended that the 'ENO' command is used rather than this one.

For example, to access byte number 234 (hex):

2XX requires OTUSR2, i.e. ENG 205

34 hex is 52 in decimal, therefore the command will be:

ENG 205 52

6.4.3 Examples of Lamp Monitor Unit Configuration Using the Handset

The LMU is configured via the handset and there are several example configurations detailed on the following pages. The main items of data to be entered and their associated handset commands are listed below:

- Define the type of output to be monitored by each current sensor (KPT)
- Allocate an aspect drive identity to each current sensor (KAD)
- Select normal lamp monitoring (i.e. NOT Red Lamp Monitoring) for each vehicle phase (KRE)

Depending on the controller configuration, the following additional data may need to be entered:

- If the controller does not have dimming fitted, disable dim/bright checking (KDP)
- If the controller enters a flashing red/amber mode (export only), define the input to disable monitoring during the flashing period (KFD)
- To monitor 50-0-50 lamps, select low voltage operation (KLV)

Example 1 - Simple 2 phase controller

Description: This is an intersection controller with 2 vehicle phases and lamp dimming.

The configuration commands are detailed below.

Enable LMU write access:

AMB = 35

NEC = 249

Allocate function of each current sensor:

KPT 1 = 1 :current sensor 1 monitors a vehicle phase

KPT 2 = 1 :current sensor 2 monitors a vehicle phase

Allocate phase identity to each current sensor:

KAD 1 = 0 :sensor 1 is phase A

KAD 2 = 1 :sensor 2 id phase B

Select normal lamp monitoring (not RLM) on vehicle phases:

KRE 1 = 0 :sensor 1

KRE 2 = 0 :sensor 2

Reset the lamp monitor and enable lamp monitoring:

KLR = 1 :reset lamp characteristics

KLE = 1 :enable lamp monitoring

Example 2 - 4 phase controller with signs

Description: Four phase intersection controller with no lamp dimming. Two of the phases are vehicle and two are pedestrian. The controller also drives regulatory signs and two switched signs.

The wait indicators in this example are monitored using their own current sensors, separately from those used to monitor the pedestrian red and green (see example 3 for combined wait and pedestrian monitoring on one current sensor).

The configuration commands are detailed below.

Enable LMU write access:

AMB = 35

NEC = 249

Allocate function of current sensor 1 to 9:

KPT 1 = 1 :a vehicle phase

KPT 2 = 1 :a vehicle phase

KPT 3 = 3 :a pedestrian phase

KPT 4 = 3 :a pedestrian phase

KPT 5 = 5 :40 W wait indicators

KPT 6 = 5 :40 W wait indicators

KPT 7 = 8 :switched sign (bulb type)

KPT 8 = 9 :switched sign (tube type)

KPT 9 = 7 :regulatory sign

Allocate aspect drive identity to each current sensor:

Note: No aspect drive required for regulatory sign.

KAD 1 = 0 :sensor 1 is phase A

KAD 2 = 1 :sensor 2 is phase B

KAD 3 = 2 :sensor 3 is phase C

KAD 4 = 3 :sensor 4 is phase D

KAD 5 = 2 :sensor 5 is phase C (wait)

KAD 6 = 3 :sensor 6 is phase D (wait)

KAD 7 = 4 :sensor 7 is phase E, red drive

KAD 8 = 20 :sensor 8 is phase E, amber drive

Select normal lamp monitoring (not RLM) on vehicle phases:

Note: Sensors 3 to 9 do not monitor vehicle phases and so they are configured for normal lamp monitoring by default - their configuration does not need to be changed.

KRE 1 = 0 :sensor 1
KRE 2 = 0 :sensor 2

Turn off dim/bright checks:
KDP = 0

Example 3 - 4 phase controller

Description: Four phase intersection controller with two vehicle and two pedestrian phases.

Each pedestrian phase is monitored with a single current sensor (see example 2 for separate wait and pedestrian monitoring using two current sensors per phase)

The configuration commands are detailed below.

Enable LMU write access:
AMB = 35
NEC = 249

Allocate function of current sensor 1 to 4:

KPT 1 = 1 :a vehicle phase
KPT 2 = 1 :a vehicle phase
KPT 3 = 12 :a pedestrian phase, including wait indicators
KPT 4 = 12 :a pedestrian phase, including wait indicators

Allocate aspect drive identity to each current sensor:

KAD 1 = 0 :sensor 1 is phase A
KAD 2 = 1 :sensor 2 is phase B
KAD 3 = 2 :sensor 3 is phase C
KAD 4 = 3 :sensor 4 is phase D

Select normal lamp monitoring (not RLM) on vehicle phases:

Note: Sensors 3 and 4 do not monitor vehicle phases and so their configuration does not need to be changed.

KRE 1 = 0 :sensor 1
KRE 2 = 0 :sensor 2

Example 4 - Pelican (single current sensor)

Description: This is a pelican controller with dimming.

In this example, the pelican is monitored with a single current sensor (see example 5 for separate wait and pedestrian and vehicle monitoring using three current sensors)

The configuration commands are detailed below.

Enable LMU write access:

AMB = 35

NEC = 249

Allocate function of current sensor 1:

KPT 1 = 11 :the current sensor monitors a complete
:pelican stream

Allocate aspect drive identity to each current sensor:

KAD 1 = 0 :sensor 1, vehicle is phase A (and so
:by implication, the pedestrian is phase B)

Example 5 - Pelican (three current sensors)

Description: This is a pelican controller with dimming.

In this example, the pelican is monitored with three current sensors (see example 4 for combined wait, pedestrian and vehicle monitoring using a single current sensor)

The configuration commands are detailed below.

Enable LMU write access:

AMB = 35

NEC = 249

Allocate function of current sensors 1 to 3:

KPT 1 = 2 :pelican vehicle phase

KPT 2 = 4 :pelican pedestrian phase

KPT 3 = 6 :60 Watt wait indicators

Allocate aspect drive identity to each current sensor:

KAD 1 = 0 :sensor 1, vehicle is phase A

KAD 2 = 1 :sensor 2, pedestrian is phase B

KAD 3 = 1 :sensor 3, wait is phase B

6.4.4 LMU Commissioning

Once the LMU has been installed in the controller, the commissioning steps are as detailed below:

- Enter the LMU configuration commands, if these have not already been loaded in (one option is to enter the configuration commands at the depot, prior to installation)

- Reset the lamp monitor and enable lamp monitoring (KLR and KLE)
- With the junction signals on, check that the voltage and current readings are as expected on each input (KAC)
- Check that all lamps are working, including wait indicators

Allow the LMU to learn the lamps and check that learning is complete (KLS)

Note: If dimming is fitted to the controller, force the signals to dim and allow the LMU to learn the lamps in the dim state.

A more detailed description of junction learning and lamp failure checking is provided in the following sections.

6.4.4.1 Junction Self Learning during Commissioning

Force the controller to cycle round all the stages (e.g. by switching into fixed time mode) and initiate learning using the KLR and KLE commands.

To be sure that each controller output has been learnt, at least three complete cycles should be allowed. Note: Some controllers may have outputs (phases) which only appear under certain conditions. The commissioning engineer may decide to force these to appear (where possible) to ensure they are learnt before leaving the site.

Once an output has been learnt the LMU will commence monitoring automatically.

During the learning cycle the commissioning engineer should walk around the junction pressing any pedestrian push buttons that have wait indicators with them, and checking that there are no lamp failures already present on the junction. Any failed lamps should be replaced after the junction has been learnt.

Note: It is not necessary to invoke the self learning function again if a faulty lamp is found during the engineer's inspection of the junction, as the lamp monitor will automatically adjust to the new situation when the lamp is replaced.

The above sections describe the minimum requirements for installing an LMU. The following give details of extra procedures and tests to improve the reliability of, and confidence in the lamp monitor installation.

6.4.4.2 Learning the Other Dim/Bright State

The sequence above will have learnt the characteristics of the junction in one of the controller states (dim or bright). To completely learn the junction the controller should be switched to the other state, i.e. to dim if already in bright or vice-versa, and again 3 complete cycles of each controller output should be allowed.

The learning of the second state is automatic once the controller has been switched to that state and requires no manual intervention.

This means that it is not strictly necessary to manually switch the controller into the other state as the second learning sequence will be invoked automatically at the first dim/bright change, after the initial learning sequence was invoked.

It should be noted however, that lamp failures cannot be detected when the controller is in a particular state (dim or bright) unless the characteristics of the junction have been learnt in that state. If the learning of the second state is left to occur automatically at the next dim/bright change and the lamp failure occurs during or just after the change, it will not be detected by the LMU until the controller reverts back to the original state in which the junction learning was invoked.

6.4.4.3 Checking that Lamp Failures are Detected

The installation engineer may check that lamp failures are indicated when they occur and that lamp replacements remove the fault indication.

These checks should be carried out after the junction characteristics have been learnt.

Remove any lamp and wait for the LMU to find the failure. Indication that the lamp failure has been found will be given by the lighting of the system fail LED on the Controller Main Processor PCB, and by the appropriate entry in the fault log.

Further lamps may be removed to check that lamp failures can be detected on other controller outputs.

6.5 MAINTENANCE

6.5.1 Status LEDs

LEDs are provided on the front edge of the board to provide basic status information. The position of these LEDs and their functions are shown in Figure 34.

A System fail on the Controller Main Processor PCB may indicate a fault on the Integral OTU PCB.

If the system fail LED is on, information about the type of fault that has occurred can be accessed using a handset terminal (see section 6.4.2 on handset commands).

Note: The OTU may still be operating normally, even with the system fail LED on, depending on the type of failure that has been detected.

If the Watchdog fail LED is illuminated the software is not running correctly and all transmission from the OTU will be halted. The only way to reset the board is to power off and then on again.

The Transmit confirm LED is on whilst correctly formatted control messages are being received by the OTU, and the information is being transferred to the controller. If a valid control message is not received for 4 seconds the transmit confirm LED will go out. Note this LED does NOT indicate that a reply message has been sent.

The Carrier detect LED should come on once a second for each control signal on the line (the LED is set by the software in response to the modem carrier detect output being set, it does not indicate that the carrier detected was a valid control message).

6.5.2 Effect of Incorrect Switch Settings on the OTU PCB

(1) S1 - 2/4 Wire Select Switch

4 wire system but with 2 wire selected in error or 2 wire system but with 4 wire selected in error; the OTU may not receive the control signal and will not reply, therefore the carrier detect and transmit confirm LEDs will be OFF.

(2) S2 - Lithium Battery On/Off Switch

If this switch is off the system fail LED will illuminate on the Controller Main Processor PCB and the Integral OTU will not communicate with the Instation.

(3) S3 - Line level switch

A 6-way DIL switch is used to set line levels. If switch positions 1 to 4, of the DIL switch, are set incorrectly the OTU will transmit at the wrong output power.

If switch positions 5 and 6 are set incorrectly the receive threshold for the OTU modem will be wrong. If it is set too low corrupted control messages may occur. If set too high the control messages from the Instation may be undetected.

(4) S4 - 600 Ohm/High Impedance Switch

If the switch is set to high impedance when it should be set to 600 Ohms, the transmit signal for all OTUs on the line and the receive signal for the particular OTU will be up to 3dB higher than if the switch was set correctly. The characteristics of the line may also be affected.

If the switch is set to 600 Ohms when it should be set to high impedance this will reduce signal levels and may upset the characteristics of the line.

6.5.3 Fault Finding at the Outstation

Symptom

System Fault LED lit on Controller Main Processor

Watchdog LED On

OTU not replying to control message

Possible Reason

Use handset to access fault log for information on the type of fault that has occurred, this may be an Integral OTU fault

Software not running correctly. Power down and up again.

OTU Switch settings incorrect
OTU configured incorrectly via the handset - repeat configuration.

Extended system bus cable disconnected/faulty.

No control data - low line level, interference BT lead disconnected / faulty.

6.5.4 Lithium Battery

The outstation PCB is fitted with a Lithium Battery (B1, part number 418/4/97186/000). This battery must be **replaced** every **4** years.

There may be a label already on the battery showing the date the battery was shipped. This should be covered with a label showing the **date the battery is fitted** into the equipment. The replacement date is therefore four years **after** the date on the label.

WARNING - Care should be taken when handling and disposing of Lithium batteries. Refer to code of practice CP526.

6.5.5 Recommended Spares

Integral OTU kit	667/1/27004/000
Lithium battery	418/4/97186/000
LMU Spares (if equipped):	
Current Transformer	667/7/25171/000
Voltage Monitoring Transformer	667/7/25172/000
Optional spares:	
Handset terminal	667/4/13296/000

Appendix A – TC12 OTU Serial Environmental Monitor Sensor Interface Handbook

The following pages comprise the full handbook 667/HB/26628/000.